Fermilab

LAPD CRYOGENIC SYSTEM

CRYOGENIC CONTROL SYSTEM, INSTRUMENTATION, and FIELD EQUIPMENT

Location: FermiLab\PC4\Fixed Target Enclosure

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ENGINEERING NOTE
REVISION A - NOV 8,2012

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PPD/MD/PROCESS CONTROLS ENGINEERING

MAY 9,2011

CONTENTS

Revision History:

Rev A

PC4 ODH classification changed from Class 1 to Class 0
ODH system adds two MSA O2 sensors to accommodate LBNE 35 ton
ODH wiring Diagram 3942.510.EE-489928 replaces 3942.510.EE-486487
3942.510.ME-444897 LAPD P&ID rev K updated to Rev M
3942.520.EE-466801 PLC wiring diagram updated to Rev D

I. Introduction

This document fulfills electrical documentation requirements set forth by the Electrical Design Standards for Electronics to be used in Experiment Apparatus at Fermilab document and EED/Infrastructure Doc. No:H011228A document published by the PPD/Electrical department.

The LAPD cryogenic test system is currently in the PC4 Underground Hall at FermiLab. The PC4 hall is classified as ODH class 0 area and has several large cryogenic and gas components. Cryogens include liquid Argon and Liquid Nitrogen.

This cryogenic system has approximately 100 electronic input sensing devices and 25 output devices. Input devices include RTD's, pressure transmitters, level transmitters, and thermocouples. Output devices include solenoid valves, variable speed motor controllers, and heaters.

There is no floor plan provided in this document due to the fact that all equipment is located in one area of PC4 and is clearly labeled.

All electronic and electrical control system equipment is air cooled and does not require any forced air cooling or water cooling. Cabinet air vents are provided for certain devices where appropriate.

The control system equipment components are all commercially available products which are Ul listed. The cryogenic control system has been designed and built following all the required rules and standards such as the NEC. All premises wiring was installed by Fermi Electrical contractors and licensed electricians.

II. Cryogenic Control System

a. Description

The LAPD cryogenic system will be controlled by a Siemens S7-400 PLC with S7-300 associated I/O modules networked on a Profibus network. This PLC system will be programmed using the Siemens S7 engineering programming software.

Human machine Interface controls will be provided through GEFANUC's iFIX software. iFIX connects to the S7-400 through Private Ethernet using an OPC driver purchased from Kepware. iFIX will handle all operator security, computer alarming, and remote operator controls via the PPD-iFIX server. iFIX will also provide historical data through the PPD-iFIX historian. This historical data will be viewable in iFIX picture displays or on the web through the iFIX proficy portal server //on D0-HIST2/proficyportal machine.

b. Electric Power and Circuit Protection

Sheet 1 of drawing "3942.520.EE-466801 LAPD S7 PLC wiring diagram rev D" shows the PLC cabinet equipment layout. It also shows the AC and DC power distribution and circuit protections. All conductors are either copper or tinned copper grade.

AC Circuit Conductor:
Min of 12 AWG downstream of 20A or less circuit protection
Min of 14 AWG downstream of 15A or less circuit protection
Min of 16 AWG downstream of 10A or less circuit protection

DC circuit Conductor AWG:
Min of 14 AWG downstream of 15A or less circuit protection
Min of 16 AWG downstream of 10A or less circuit protection
Min of 22 AWG downstream of 5A or less circuit protection

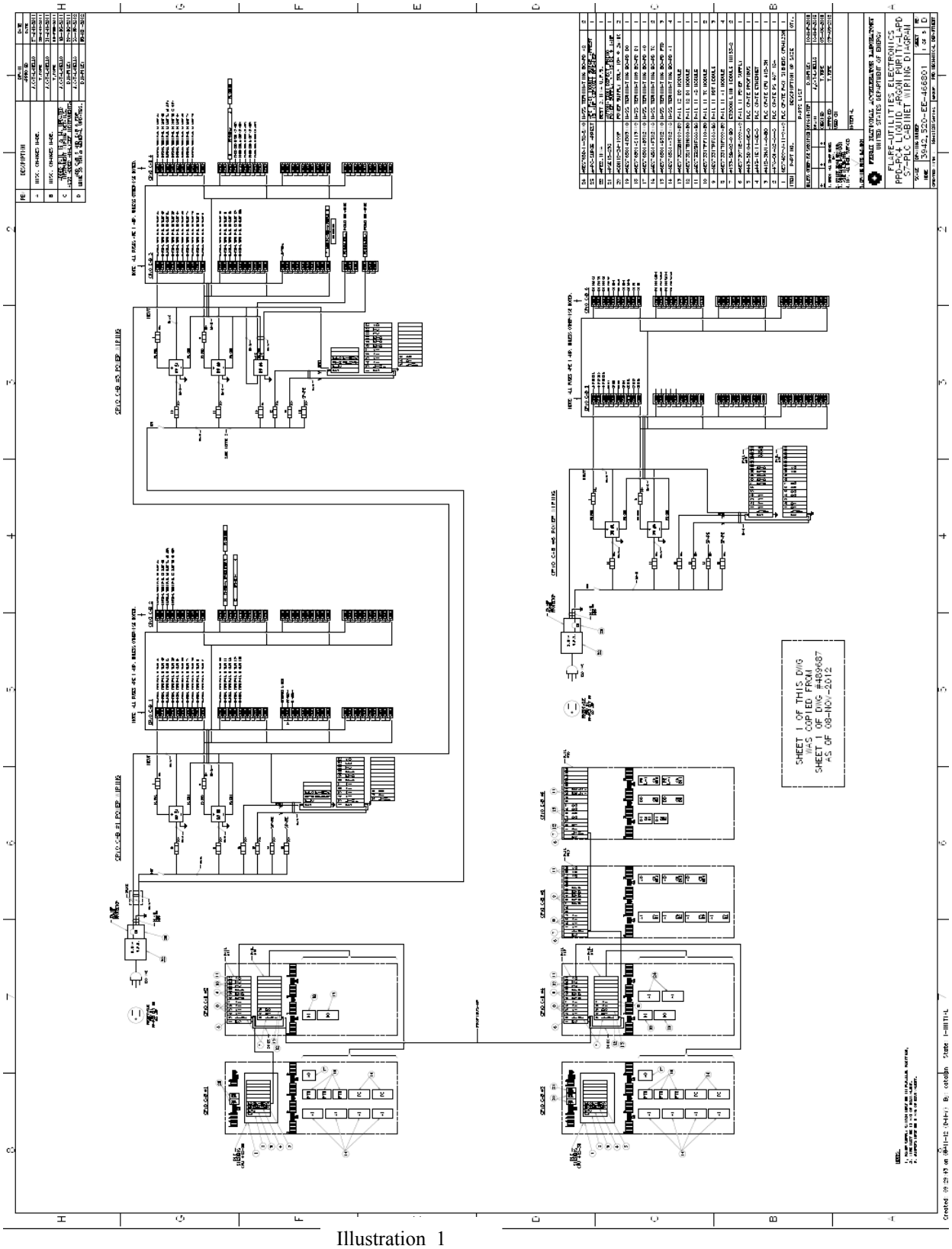


Illustration 1

III. Field Devices and Components

a. Heater HTR612A

i. Description

Heater 612A is a commercial 1200 watt Omega in line gas heater. This heater has an analog power control circuit for variable power control. The heater has an internal "k" thermocouple which is connected to a limit control device with an independent power disconnect relay. This limit control device has a mechanical dial which sets the high temperature trip limit temperature. This limit control device will protect the heater element from destructive high heater temperatures caused by equipment malfunctions and operator errors.

ii. Electric Power and Circuit Protection

Heater 612A is powered by 208VAC 1 phase power. The power is fed from a premises powered outlet. The heater control box is connected to this outlet using a standard molded ac cord. The heater control box has internal fuses on the heater power circuit and the control circuit. The downstream conductors are sized and rated to meet the minimum current capacity of these fuses. See illustration 2.

b. Heater HTR634A

i. Description

Heater HTR634A is a commercial 1200 watt Omega in line gas heater. This heater has an analog power control circuit for variable power control. The heater has an internal "k" thermocouple which is connected to a limit control device with an independent power disconnect relay. This limit control device has a mechanical dial which sets the high temperature trip limit temperature. This limit control device will protect the heater element from destructive high heater temperatures caused by equipment malfunctions and operator errors.

ii. Electric Power and Circuit Protection

Heater HTR634A is powered by 208VAC 1 phase power. The power is fed from a premises powered outlet. The heater control box is connected to this outlet using a standard molded ac cord. The heater control box has internal fuses on the heater power circuit and the control circuit. The downstream conductors are sized and rated to meet the minimum current capacity of these fuses. See illustration 2.

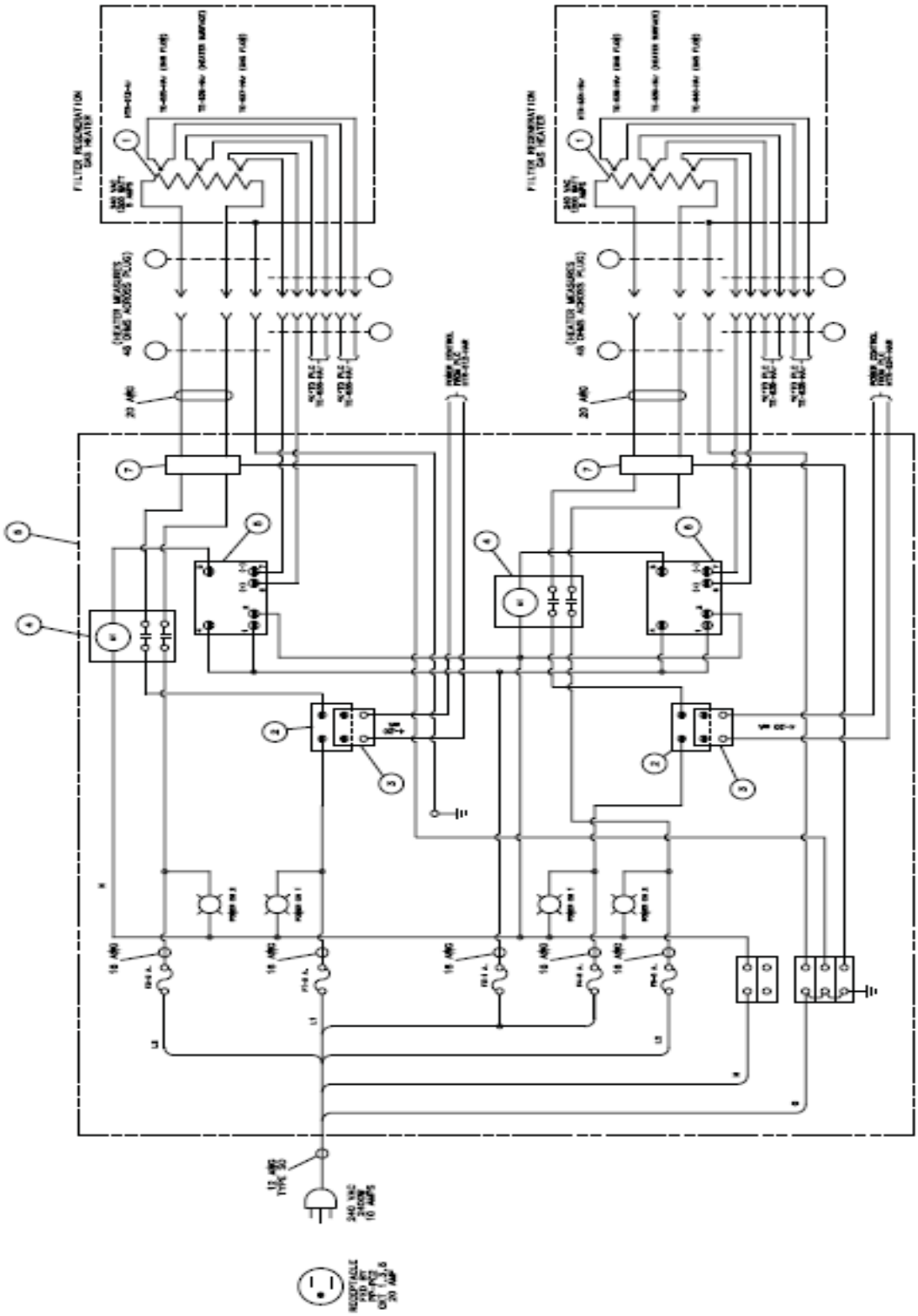


Illustration 2

c. Heater HTR1_TANK_A(HTR385A-HTR396A)

i. Description

Heater HTR1_TANK_A is a network of WatLow Polyimide flexible heaters attached to the LAr vessel. The network consist of 6 parallel groups of two series heaters. Each heater is rated for 100 watts, but there are two in series for an expected power of 50 watts each. This heater has an analog power control circuit for variable power control. Each group of two heaters has an RTD sensor between the two heaters which is readout by the S7 PLC system. All six RTD sensors in this heater network will be monitored and interlocked by the PLC. Special attention will be paid to these RTD for high temperature interlocks. This heater control system has a separate power relay from the analog control circuit which is controlled by the S7 PLC and functions as a power cutout to the heaters on an interlock.

ii. Electric Power and Circuit Protection

Heater HTR1_TANK_A is powered by 208VAC 1 phase power. The power is fed from a premises powered outlet. The heater control box is connected to this outlet using a standard molded ac cord. The heater control box has internal fuses on the heater power circuit and the control circuit. The downstream conductors are sized and rated to meet the minimum current capacity of these fuses. See illustration 3.

d. Heater HTR2_TANK_A(HTR397A-HTR408A)

i. Description

Heater HTR2_TANK_A is a network of WatLow Polyimide flexible heaters attached to the LAr vessel. The network consist of 6 parallel groups of two series heaters. Each heater is rated for 100 watts, but there are two in series for an expected power of 50 watts each. This heater has an analog power control circuit for variable power control. Each group of two heaters has an RTD sensor between the two heaters which is readout by the S7 PLC system. All six RTD sensors in this heater network will be monitored and interlocked by the PLC. Special attention will be paid to these RTD for high temperature interlocks. This heater control system has a separate power relay from the analog control circuit which is controlled by the S7 PLC and functions as a power cutout to the heaters on an interlock.

ii. Electric Power and Circuit Protection

Heater HTR2_TANK_A is powered by 208VAC 1 phase power. The power is fed from a premises powered outlet. The heater control box is connected to this outlet using a standard molded ac cord. The heater control box has internal fuses on the heater power circuit and the control circuit. The downstream conductors are sized and rated to meet the minimum current capacity of these fuses. See illustration 3.

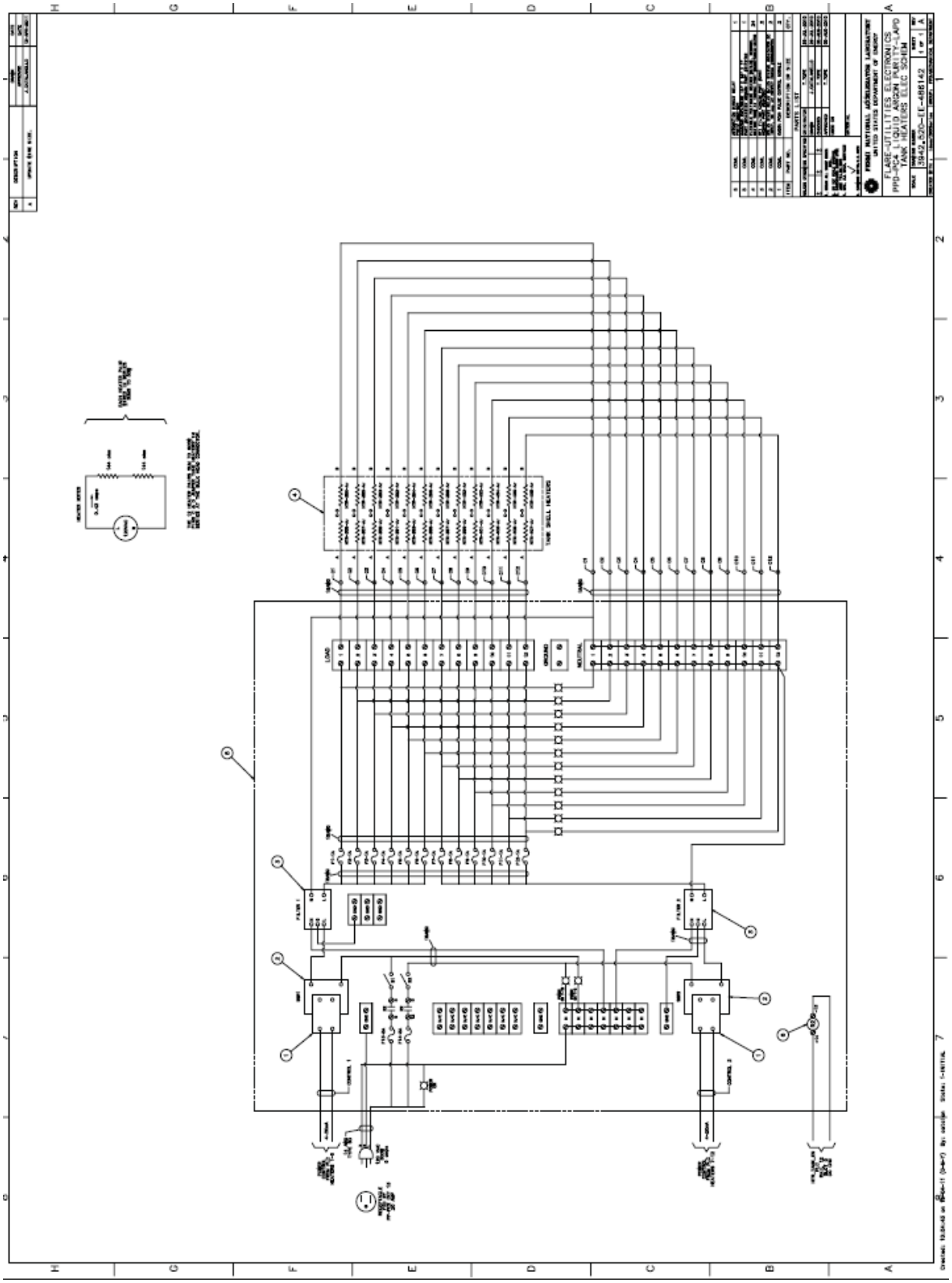


Illustration 3

e. VFD(Variable Frequency Drive) LAr Pump

i. Description

The VFD is a commercial unit designed to run a standard AC 3 phase motor at variable speeds given a standard control analog input signal. A discrete input will direct the VFD to the off or run mode. The S7 PLC will monitor various Argon system process parameters and provide programmed interlocks and speed control from the S7 PLC.

ii. Electric Power and Circuit Protection

The VFD is fed from premises power with a fused disconnect within sight of the VFD and motor. The VFD will be programmed with the motor data. The VFD has numerous internal motor protection settings which will interlock the motor power upon a fault.

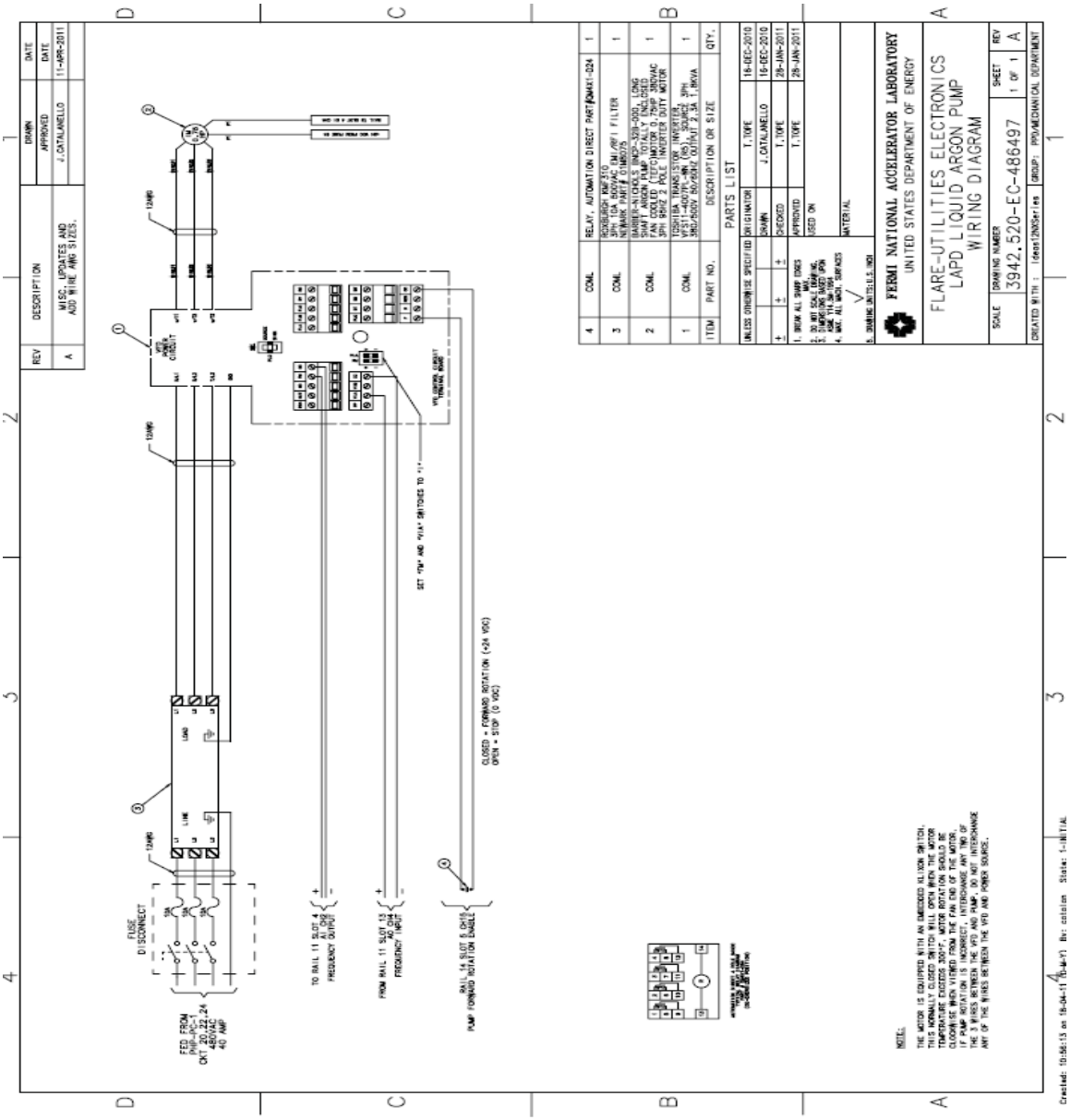


Illustration 4

f. ODH Control System

i. Description

The ODH system has been upgraded to handle up to four MSA O2 heads. Two O2 heads are currently in service for the LAPD vessel, with another two O2 sensors reserved for the LBNE 35 ton tank area.

The ODH system currently deploys two MSA O2 heads in the PC4 hall, these two sensors are near the LAr vessel. These sensors are about a foot off the floor. There are two sets of ODH warning horns and strobe lamps, one set is located at the PC4 ground level entry and the other set is located in the PC4 hall near the LAr vessel. There are two ventilation fans that pull air out of the PC4 hall and vent it outside. These fans are controlled by the S7 PLC and can also be run locally using a switch mounted near the fan unit. The ODH system is hardwired to both fans such that during an ODH alarm both fans run.

The O2 Sensors are MSA model A-UltimaX-PL-A-14-03D2-0000-100 and have a span of 0-25%. Each O2 sensor is wired to an MSA electronic controller which provides an analog output signal wired to the S7 PLC.This MSA electronic unit also provides relays which have three O2 level alarms thresholds, 18.5%, 18%, and 17.5%. The relay output that is set at 18.5% is wired directly to the ODH warning horns and strobe lamps located in PC4 and FIRUS. The MSA electronic unit also provides a trouble relay output which is also wired to the PLC and FIRUS. The trouble output is a wired in a failsafe manner, such that loss of power or blown fuse to the ODH controls will generate a trouble alarm.

ii. Electric Power and Circuit Protection

The MSA equipment is wired directly to its own self contained control circuitry in its own enclosure which can be seen in illustration 5. This self contained enclosure has its own power supply which is independent of the PLC control system, allowing the ODH system to function independently of the PLC control system. The power for this ODH system comes from the UPS.

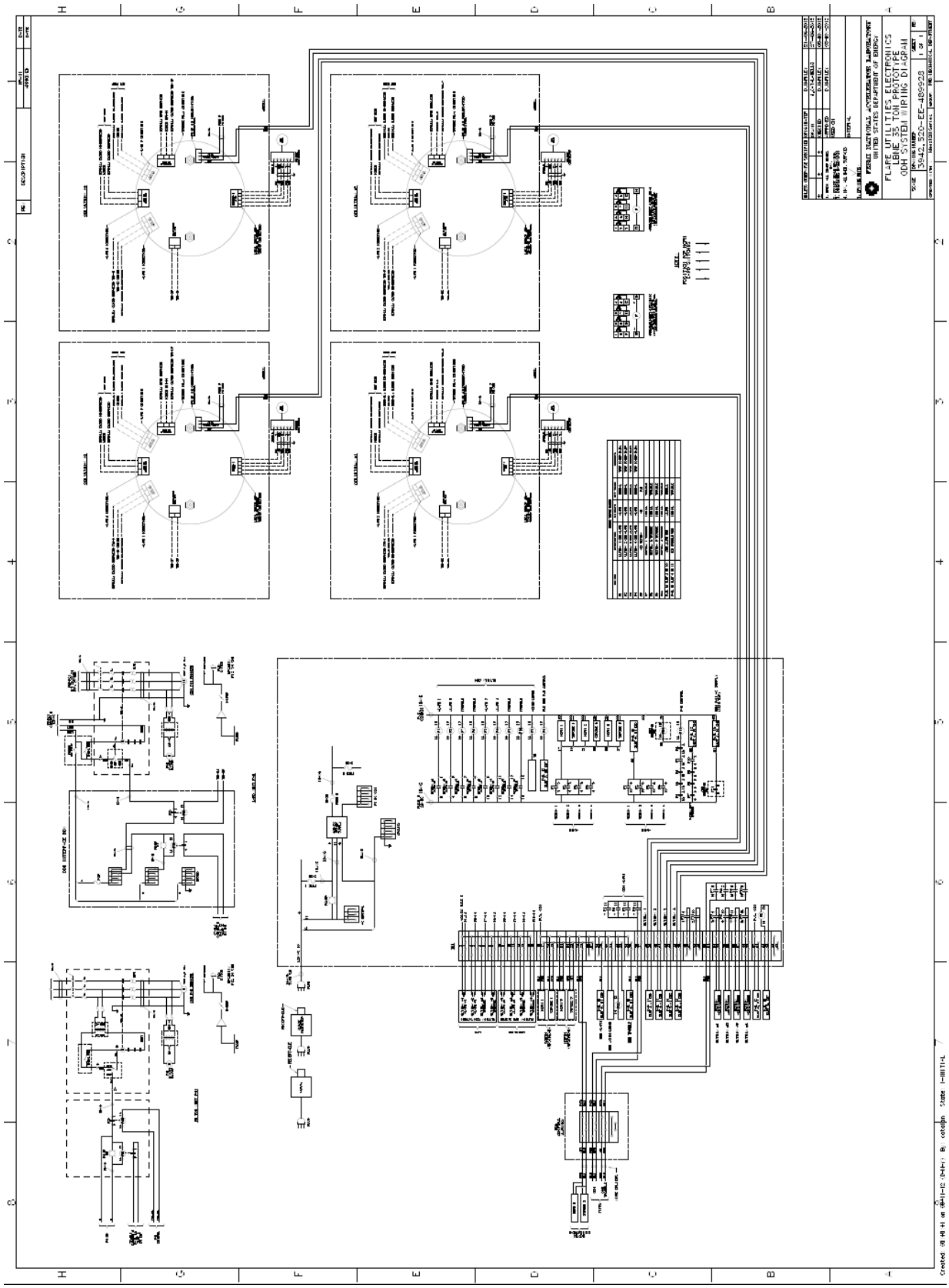


Illustration 5

h. Electric Vaporizer

i. Description

The electric vaporizer is a commercial heater unit which heats two phase gas up to about room temperature. It operates on 480VAC 3 phase power. The temperature controls are self contained and provided by the manufacturer.

ii. Electric Power and Circuit Protection

The electric vaporizer is fed from premises power with a fused disconnect within sight of the unit.

i. U.P.S

i. Description

The control system U.P.S. is commercial 1.5 kw unit manufactured by Best power. The U.P.S. input power is fed from a premises powered outlet using the U.P.S. input line cord.

ii. Electric Power and Circuit Protection

The U.P.S. has standard outlets located on the rear of the cabinet. An APC surge protector is located on the U.P.S. and its input power cord is plugged into the U.P.S output outlets. All relevant control system loads are plugged into the APC surge protector output outlets.

IV. References

a. Drawings

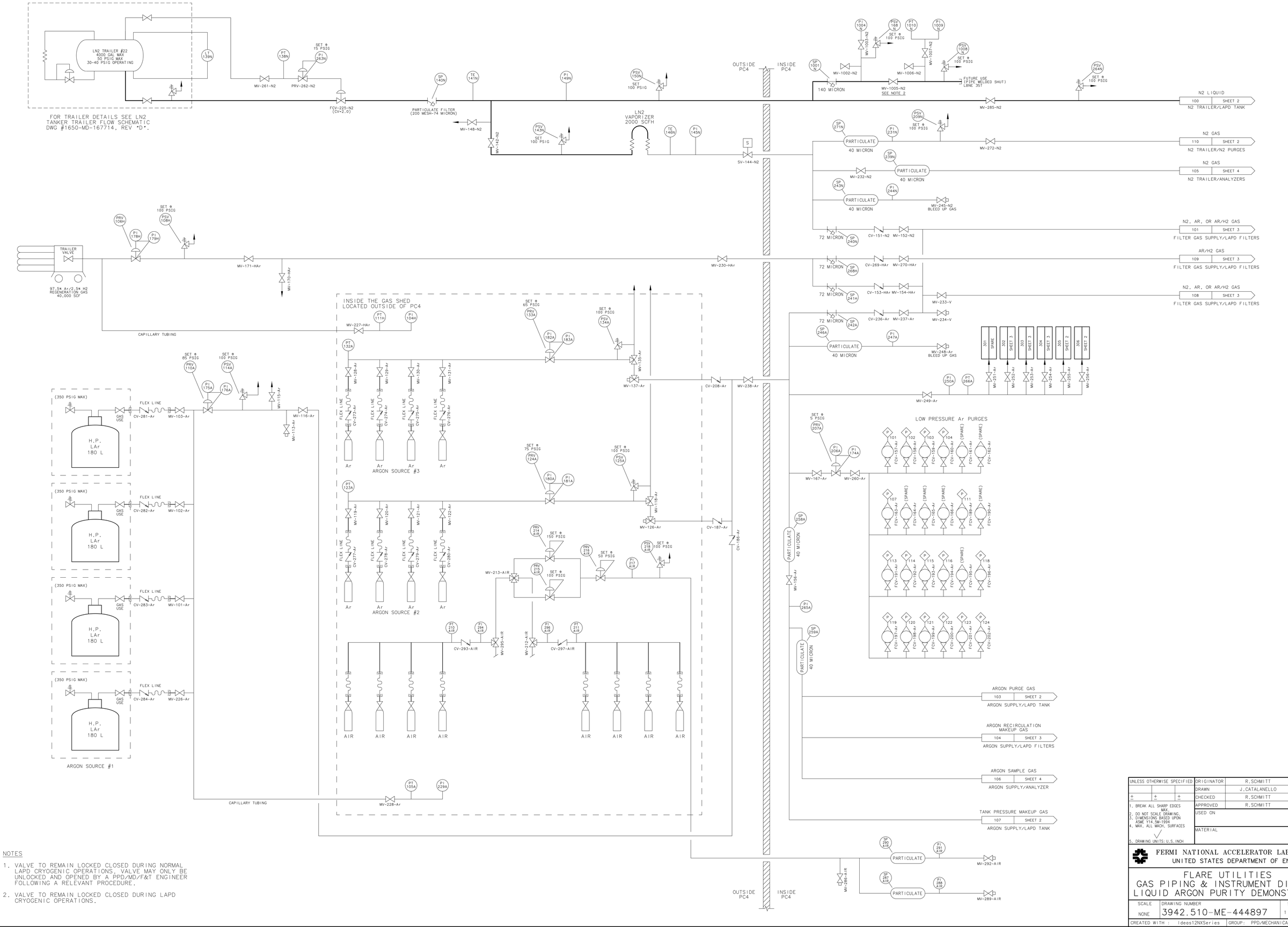
3942.510.ME-444897 LAPD P&ID rev M
3942.520.EE-466801 LAPD S7 PLC wiring diagram rev D
3942.520.EE-446145 LAPD Regeneration Gas heater wiring rev A
3942.520.EE-486142 LAPD Tank Gas heater wiring rev A
3942.520.EC-486497 LAPD LAr pump wiring rev A
3942.510.EE-489928 LBNE 35 ton ODH control system wiring rev A

b. Documents

Electrical Design Standards for Electronics to be used in Experiment Apparatus at Fermilab

EED/Infrastructure Doc. No:H011228A

REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE
M	MISC. REVISIONS MADE.	J.CATALANELLO	22-MAY-2012
L	MISC. REVISIONS MADE.	J.CATALANELLO	11-JUL-2011
		T.TOPE	01-MAR-2012
K	MISC. REVISIONS MADE.	J.CATALANELLO	04-MAR-2011
		T.TOPE	22-JUN-2011
J	MISC. REVISIONS MADE.	J.CATALANELLO	23-FEB-2011
		T.TOPE	28-FEB-2011
H	MISC. REVISIONS MADE.	J.CATALANELLO	10-JAN-2011
		T.TOPE	03-FEB-2011
G	MISC. REVISIONS MADE.	J.CATALANELLO	10-JAN-2011
		T.TOPE	12-JAN-2012
F	MISC. REVISIONS MADE.	J.CATALANELLO	26-FEB-2010
		M.ADAMOWSKI	26-FEB-2010
A	ADDED TAG NUMBERS TO VALVE TYPES	V. MAJDANSKI	25FEB08
		R. SCHMITT	26FEB08
B	MOVE CONDENSOR OUTSIDE TANK	J.CATALANELLO	07-DEC-2008
		R.SCHMITT	10-DEC-2008
C	MISC. REVISIONS MADE.	J.CATALANELLO	23-DEC-2008
		R.SCHMITT	06-JAN-2009
D	MISC. REVISIONS MADE.	J.CATALANELLO	17-NOV-2009
		T.TOPE	14-DEC-2009
E	MISC. REVISIONS MADE.	J.CATALANELLO	17-NOV-2009
		T.TOPE	15-JAN-2010



NOTES

1. VALVE TO REMAIN LOCKED CLOSED DURING NORMAL LAPD CRYOGENIC OPERATIONS. VALVE MAY ONLY BE UNLOCKED AND OPENED BY A PPD/MD/F&T ENGINEER FOLLOWING A RELEVANT PROCEDURE.
2. VALVE TO REMAIN LOCKED CLOSED DURING LAPD CRYOGENIC OPERATIONS.

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	DRAWN	J.CATALANELLO	07-DEC-2007
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2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES	USED ON		
5. DRAWING UNITS: U.S. INCH	MATERIAL		

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FLARE UTILITIES
GAS PIPING & INSTRUMENT DIAGRAM
LIQUID ARGON PURITY DEMONSTRAT'N

SCALE	DRAWING NUMBER	SHEET	REV
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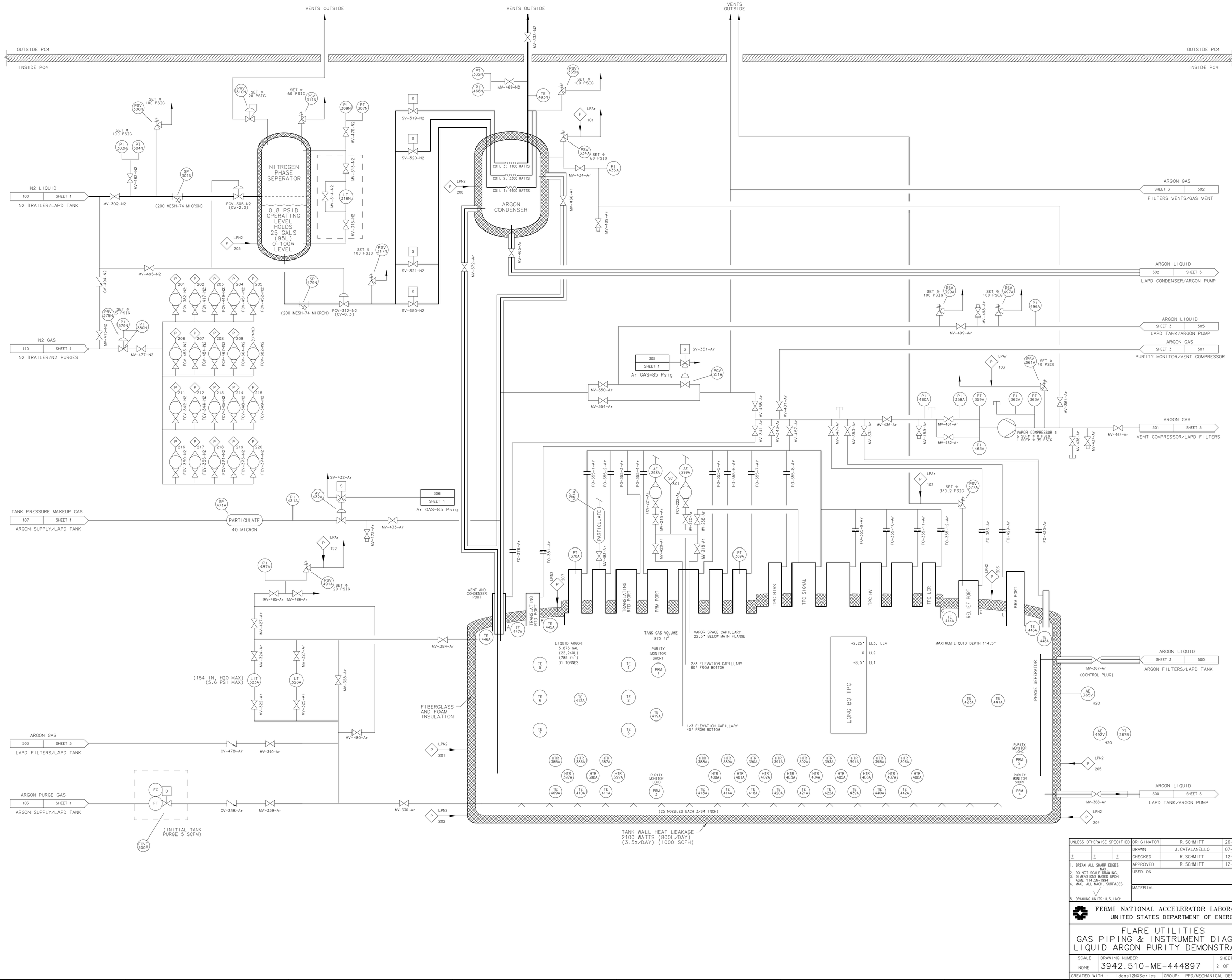

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5. DRAWING UNITS: U.S. INCH			MATERIAL		

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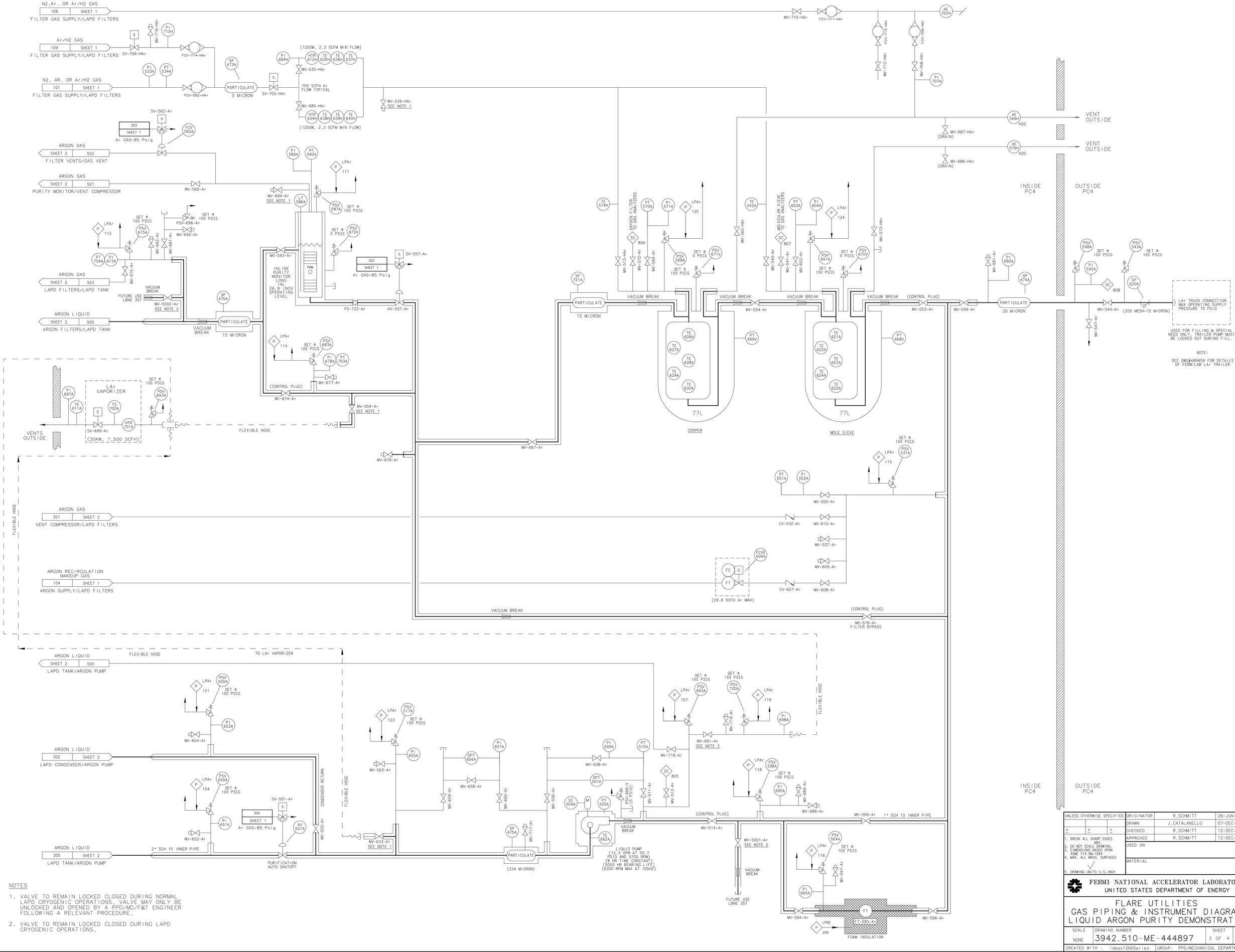

NOTES

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2. VALVE TO REMAIN LOCKED CLOSED DURING LAPD CRYOGENIC OPERATIONS.

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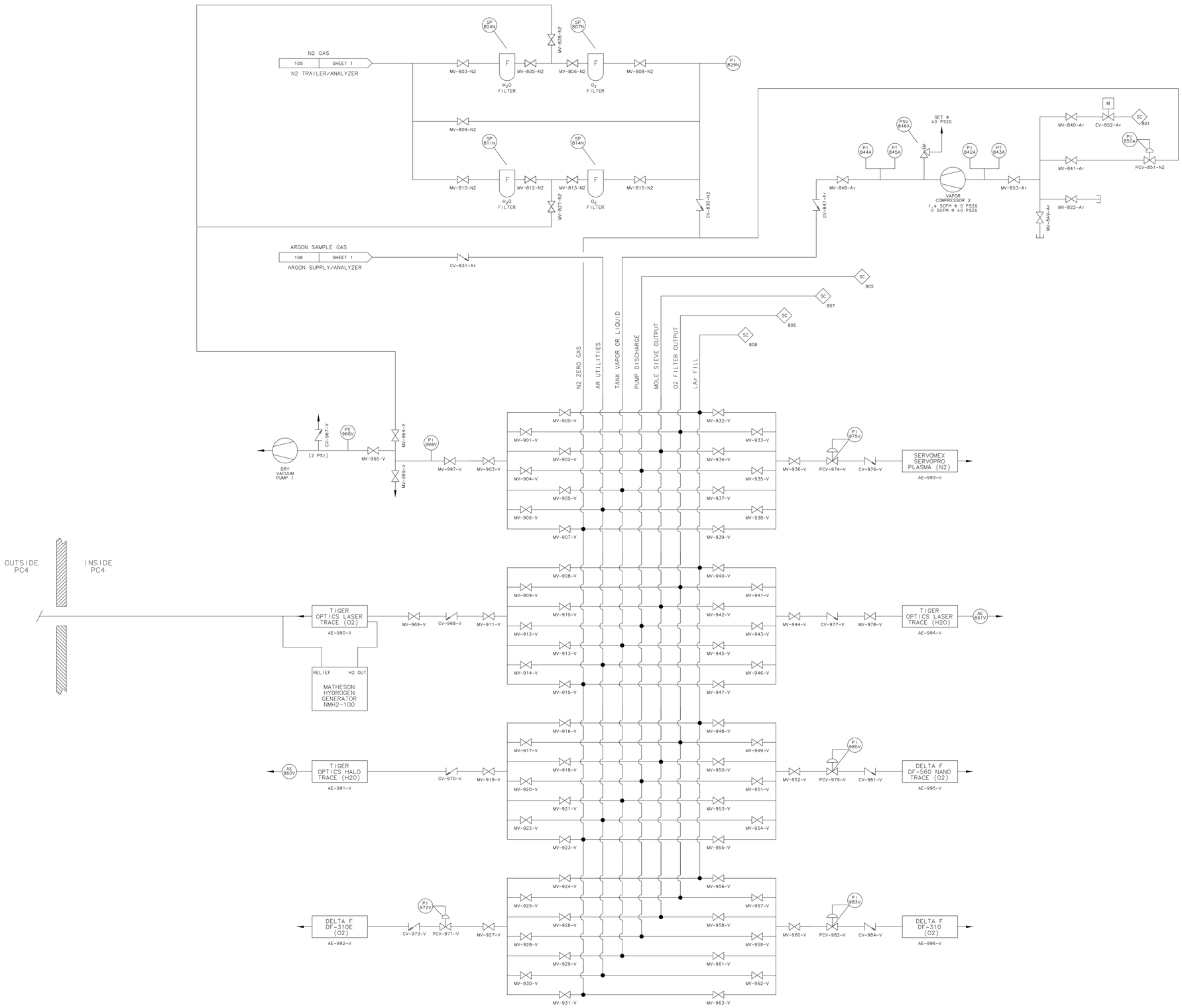

GAS ANALYZER DISTRIBUTION

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2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES			USED ON		
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FLARE UTILITIES
GAS PIPING & INSTRUMENT DIAGRAM
LIQUID ARGON PURITY DEMONSTRAT'N

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		APPROVED	DATE
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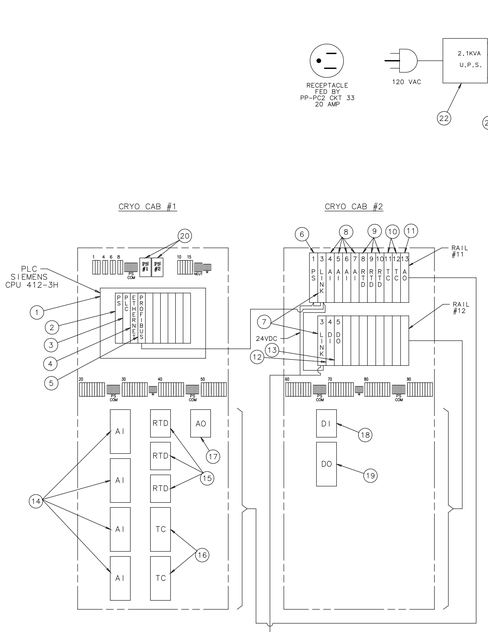
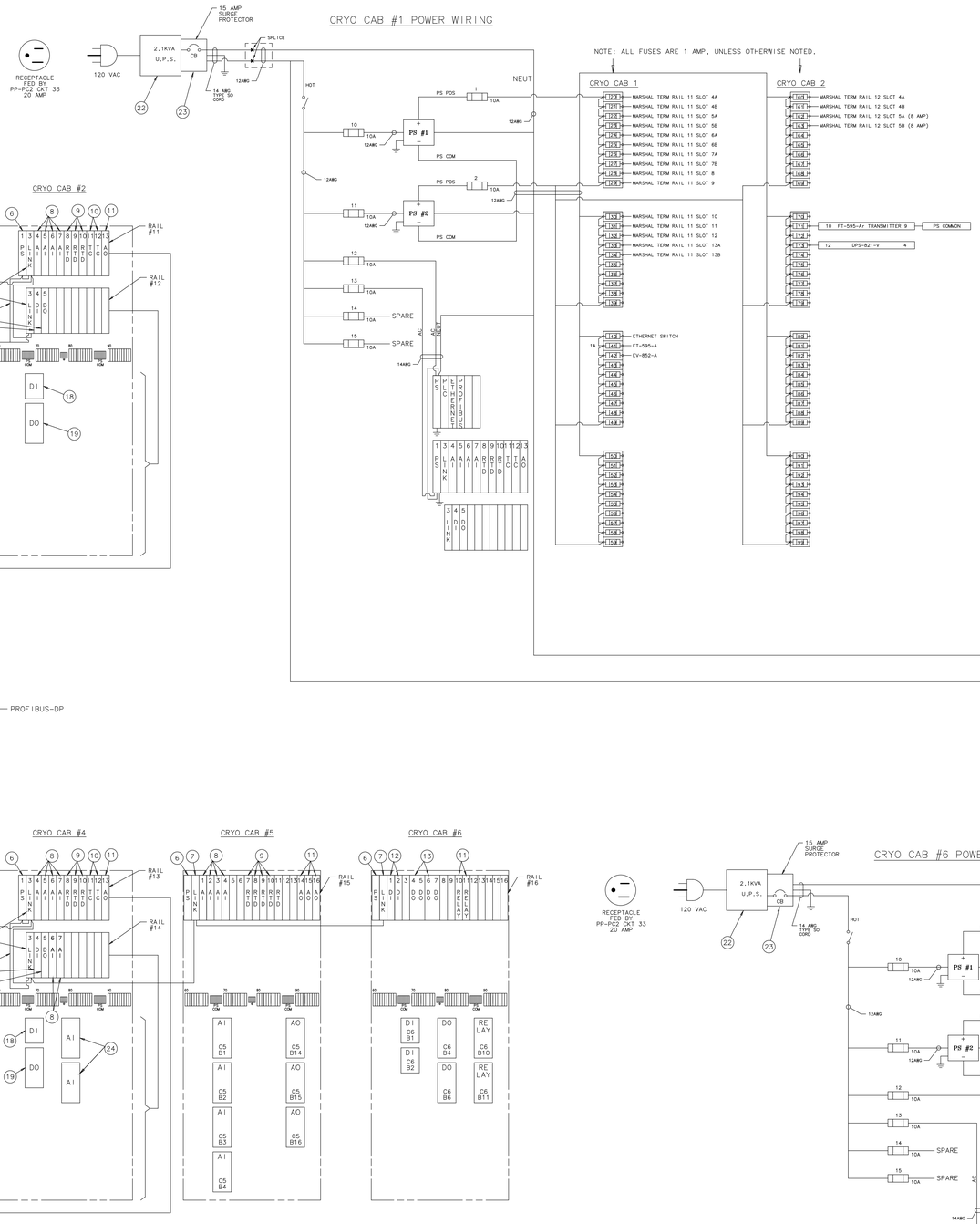
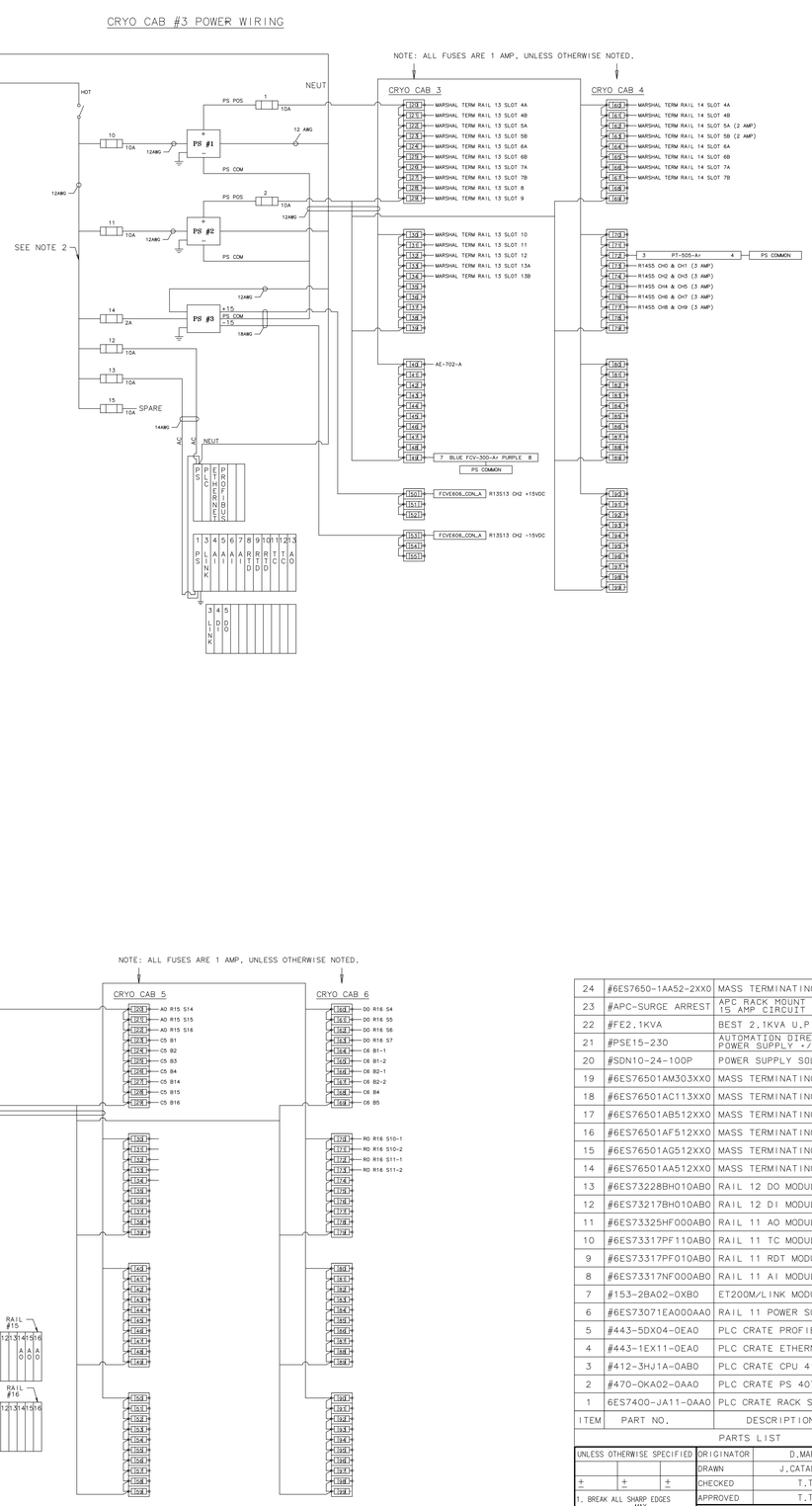
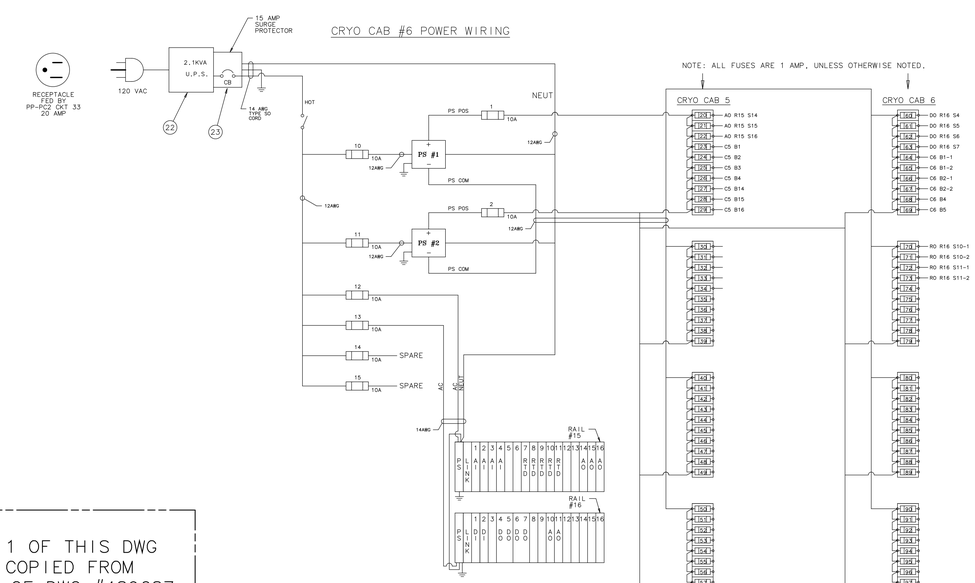
		T.TOPE	28-JAN-2011
B	MISC. CHANGES MADE.	J.CATALANELLO	31-JAN-2011
		T.TOPE	03-FEB-2011
C	ADDED RAIL 13 & 14. UPDATED INSTRUMENT WIRING DETAILS. ALSO ADDED ANALYZER INSTRUMENTS	J.CATALANELLO	18-AUG-2011
		D.MARKLEY	29-AUG-2011
D	ADD CAB 5 AND CAB 6 FOR LBNE 35 TON & GENERAL UPDATES.	J.CATALANELLO	30-APR-2012
		D.MARKLEY	08-NOV-2012









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24	#6ES7650-1AA52-2XX0	MASS TERMINATING BOARD A2	2
23	#APC-SURGE ARREST	APC RACK MOUNT SURGE ARREST 15 AMP CIRCUIT BREAKER	1
22	#FE2.1KVA	BEST 2.1KVA U.P.S.	1
21	#PSE15-230	AUTOMATION DIRECT RHINO POWER SUPPLY +/-15VDC @ 1AMP	1
20	#SDN10-24-100P	POWER SUPPLY SOLA 10A @ 24VDC	2
19	#6ES76501AM303XX0	MASS TERMINATING BOARD DO	1
18	#6ES76501AC113XX0	MASS TERMINATING BOARD DI	1
17	#6ES76501AB512XX0	MASS TERMINATING BOARD AO	1
16	#6ES76501AF512XX0	MASS TERMINATING BOARD TC	2
15	#6ES76501AG512XX0	MASS TERMINATING BOARD RTD	3
14	#6ES76501AA512XX0	MASS TERMINATING BOARD AI	4
13	#6ES73228BH010AB0	RAIL 12 DO MODULE	1
12	#6ES73217BH010AB0	RAIL 12 DI MODULE	1
11	#6ES73325HF000AB0	RAIL 11 AO MODULE	1
10	#6ES73317PF110AB0	RAIL 11 TC MODULE	2
9	#6ES73317PF010AB0	RAIL 11 RDT MODULE	3
8	#6ES73317NF000AB0	RAIL 11 AI MODULE	4
7	#153-2BA02-0XB0	ET200M/LINK MODULE IM153-2	2
6	#6ES73071EA000AA0	RAIL 11 POWER SUPPLY	1
5	#443-5DX04-0EA0	PLC CRATE PROFIBUS	1
4	#443-1EX11-0EA0	PLC CRATE ETHERNET	1
3	#412-3HJ1A-0AB0	PLC CRATE CPU 412-3H	1
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PARTS LIST

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2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES			USED ON		
5. DRAWING UNITS: U.S.INCH			MATERIAL		

SHEET 1 OF THIS DWG
WAS COPIED FROM
SHEET 1 OF DWG #489687
AS OF 08-NOV-2012

NOTES:

1. POWER SUPPLY SWITCH MOST BE IN PARALLEL POSITION.
2. WIRE MUST BE 12 AWG OR EQUIVALENT.
3. JUMPERS MUST BE 8 AWG OR EQUIVALENT.

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FLARE-UTILITIES ELECTRONICS PPD-PC4 LIQUID ARGON PURITY-LAPD S7-PLC CABINET WIRING DIAGRAM

SCALE	DRAWING NUMBER	SHEET	REV
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CREATED WITH : Ideas12NXSeries	GROUP: PPD/MECHANICAL DEPARTMENT		

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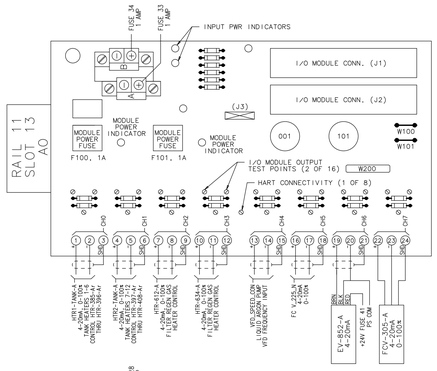
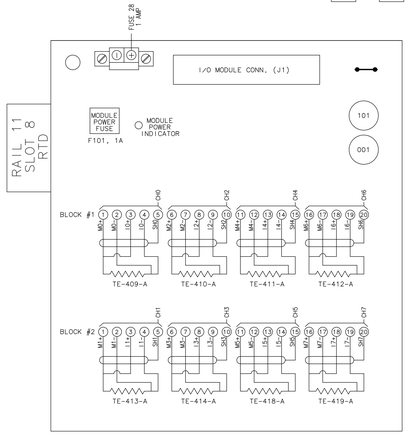
CABINET 1

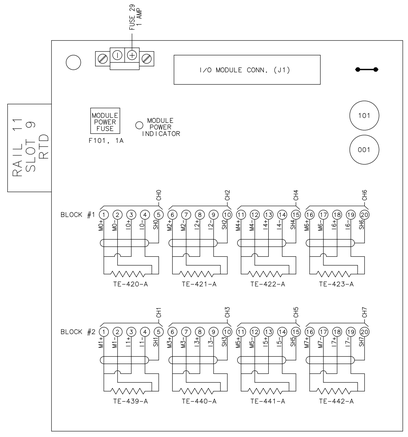
RAIL 11 SLOT 13 AO



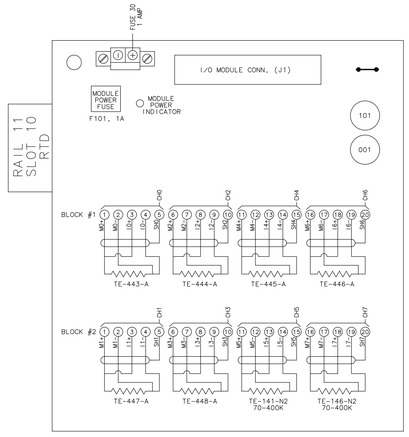
RAIL 11 SLOT 8 RTD



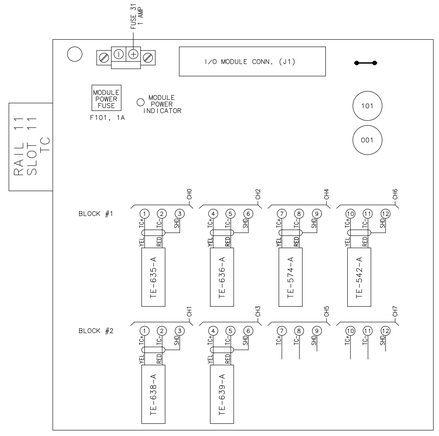
RAIL 11 SLOT 9 RTD



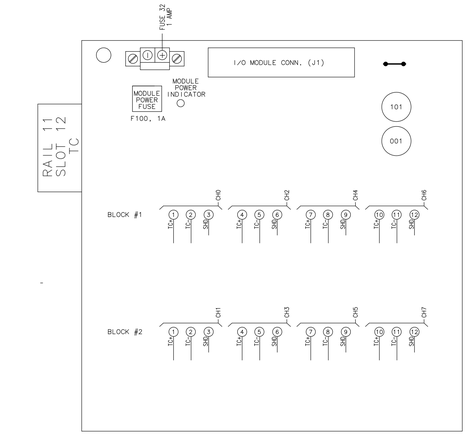
RAIL 11 SLOT 10 RTD



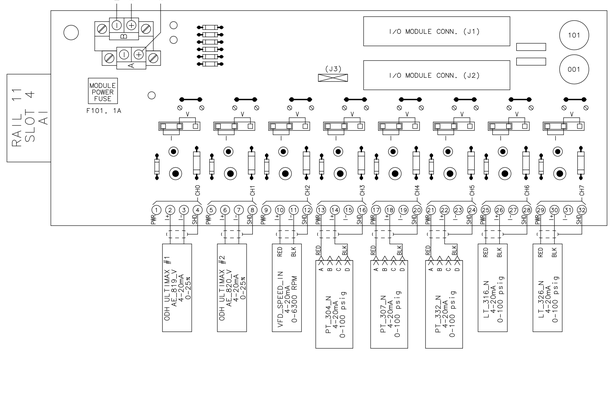
RAIL 11 SLOT 11 TC



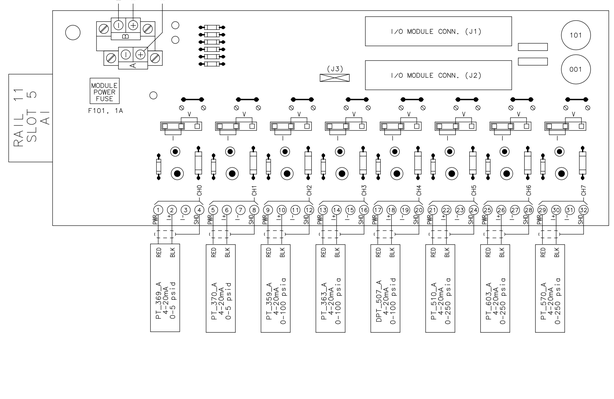
RAIL 11 SLOT 12 TC



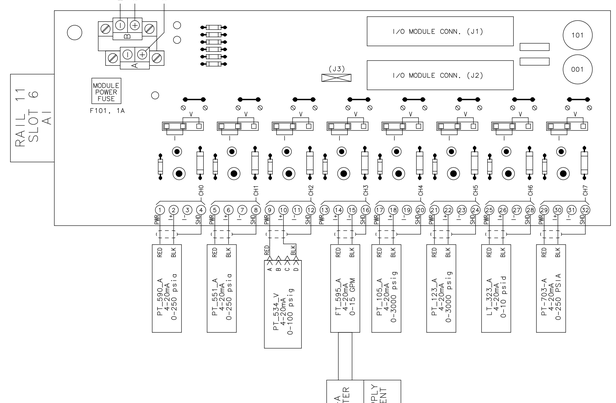
RAIL 11 SLOT 4 AI



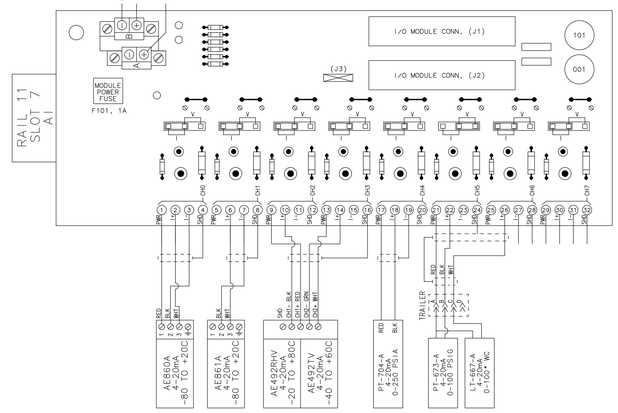
RAIL 11 SLOT 5 AI



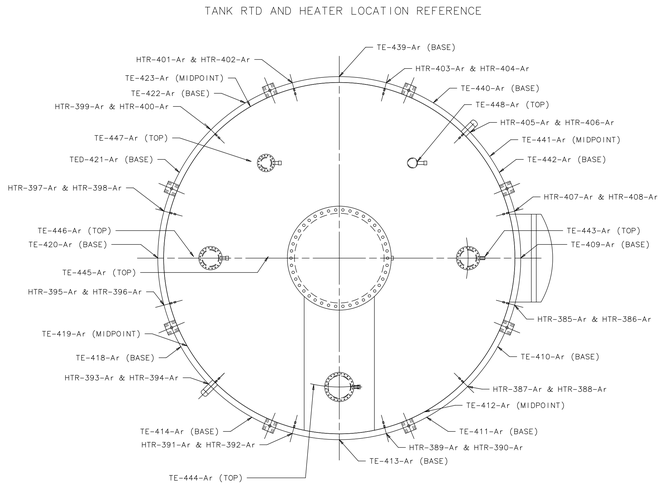
RAIL 11 SLOT 6 AI



RAIL 11 SLOT 7 AI



TANK RTD AND HEATER LOCATION REFERENCE



NOTES:

1. POWER SUPPLY SWITCH MOST BE IN PARALLEL POSITION.
2. WIRE MUST BE 12 AWG OR EQUIVALENT.
3. JUMPERS MUST BE 8 AWG OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED			ORIGINATOR	D.MARKLEY	10-MAR-2010
			DRAWN	J.CATALANELLO	10-MAR-2010
±	±	±	CHECKED	T.TOPE	05-AUG-2010
1. BREAK ALL SHARP EDGES MAX.			APPROVED	T.TOPE	05-AUG-2010
2. DO NOT SCALE DRAWING.			USED ON		
3. DIMENSIONS BASED UPON ASME Y14.5M-1994					
4. MAX. ALL MACH. SURFACES			MATERIAL		
5. DRAWING UNITS: U.S. INCH					

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

FLARE-UTILITIES ELECTRONICS PPD-PC4 LIQUID ARGON PURITY-LAPD S7-PLC CABINET WIRING DIAGRAM

SCALE	DRAWING NUMBER	SHEET	REV
NONE	3942.520-EE-466801	2 OF 1	D
CREATED WITH : Ideas12NXSeries	GROUP: PPD/MECHANICAL DEPARTMENT		

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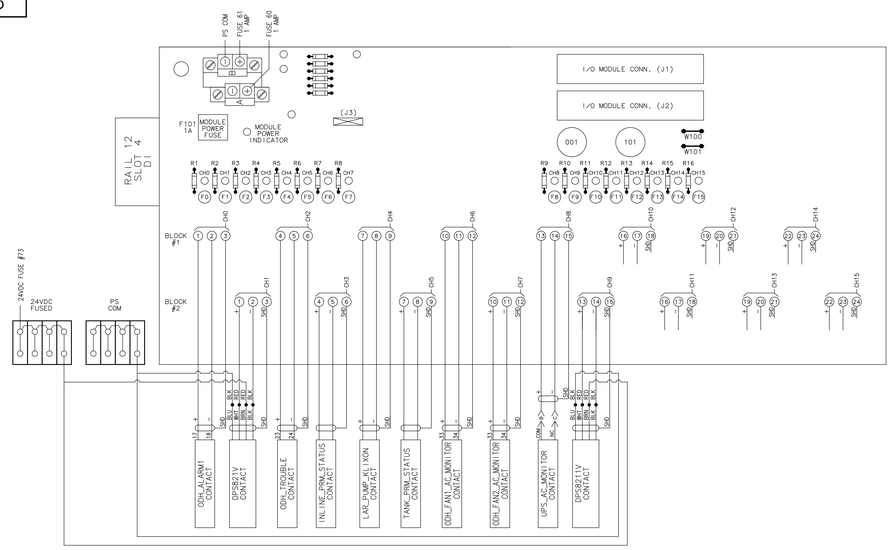
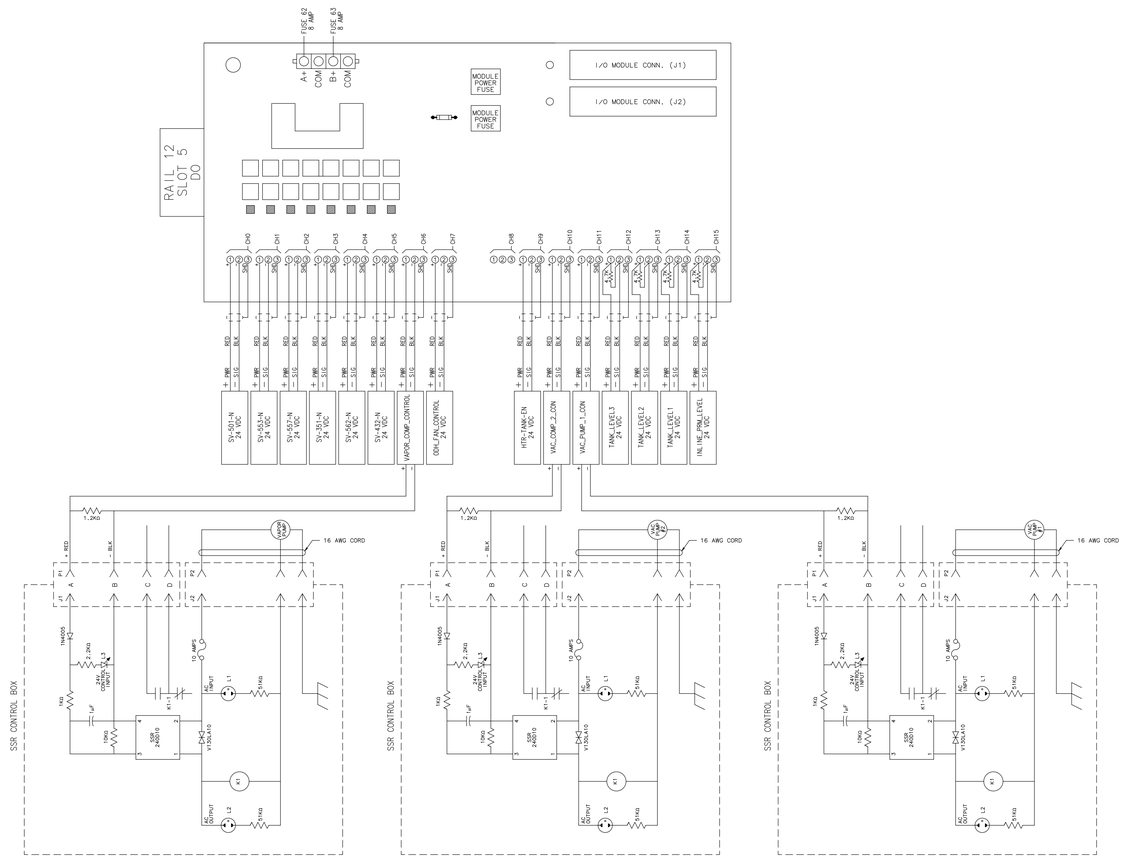
CABINET 2





NOTES:

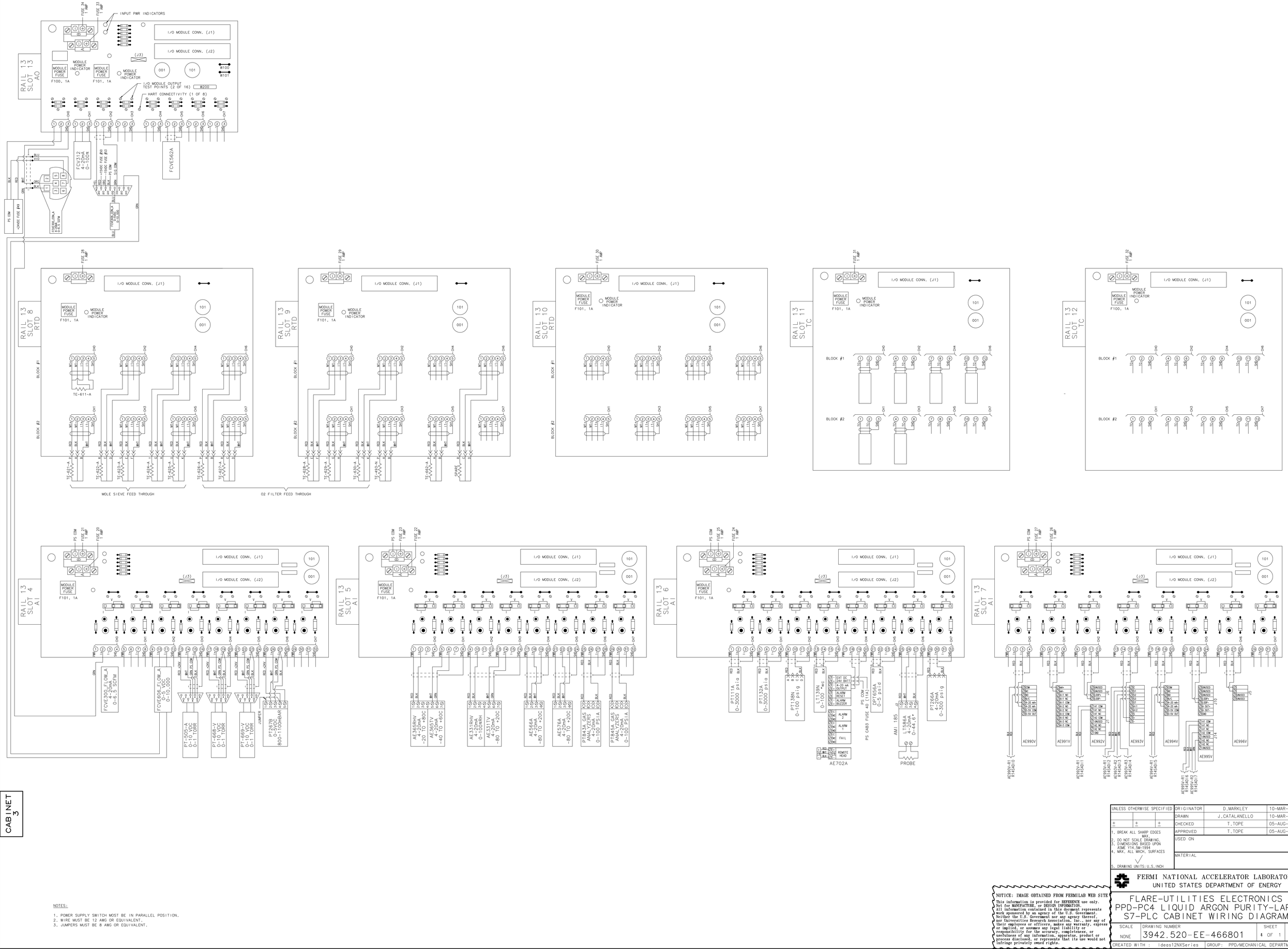
1. POWER SUPPLY SWITCH MOST BE IN PARALLEL POSITION.
2. WIRE MUST BE 12 AWG OR EQUIVALENT.
3. JUMPERS MUST BE 8 AWG OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED			ORIGINATOR	D.MARKLEY	10-MAR-2010
			DRAWN	J.CATALANELLO	10-MAR-2010
±	±	±	CHECKED	T.TOPE	05-AUG-2010
1. BREAK ALL SHARP EDGES MAX.			APPROVED	T.TOPE	05-AUG-2010
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES			USED ON		
5. DRAWING UNITS: U.S.INCH			MATERIAL		

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

FLARE-UTILITIES ELECTRONICS PPD-PC4 LIQUID ARGON PURITY-LAPD S7-PLC CABINET WIRING DIAGRAM

SCALE	DRAWING NUMBER	SHEET	REV
NONE	3942.520-EE-466801	3 OF 1	D
CREATED WITH : Ideas12NXSeries		GROUP: PPD/MECHANICAL DEPARTMENT	



CABINET 3

NOTES:

1. POWER SUPPLY SWITCH MOST BE IN PARALLEL POSITION.
2. WIRE MUST BE 12 AWG OR EQUIVALENT.
3. JUMPERS MUST BE 8 AWG OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED			ORIGINATOR	D.MARKLEY	10-MAR-2010
			DRAWN	J.CATALANELLO	10-MAR-2010
±	±	±	CHECKED	T.TOPE	05-AUG-2010
1. BREAK ALL SHARP EDGES MAX.			APPROVED	T.TOPE	05-AUG-2010
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994			USED ON		
4. MAX. ALL MACH. SURFACES			MATERIAL		
5. DRAWING UNITS: U.S. INCH					

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

FLARE-UTILITIES ELECTRONICS PPD-PC4 LIQUID ARGON PURITY-LAPD S7-PLC CABINET WIRING DIAGRAM

SCALE	DRAWING NUMBER	SHEET	REV
NONE	3942.520-EE-466801	4 OF 1	D

CREATED WITH : Ideas12NXSeries | GROUP: PPD/MECHANICAL DEPARTMENT

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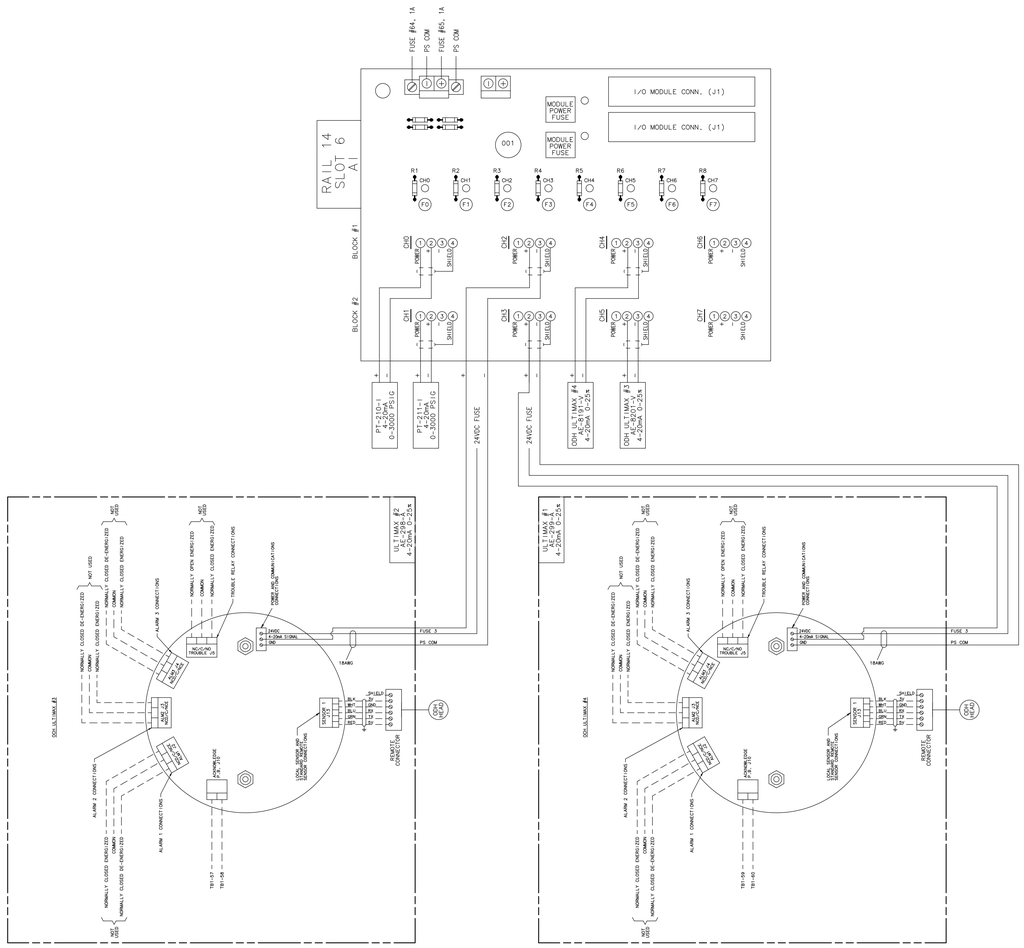
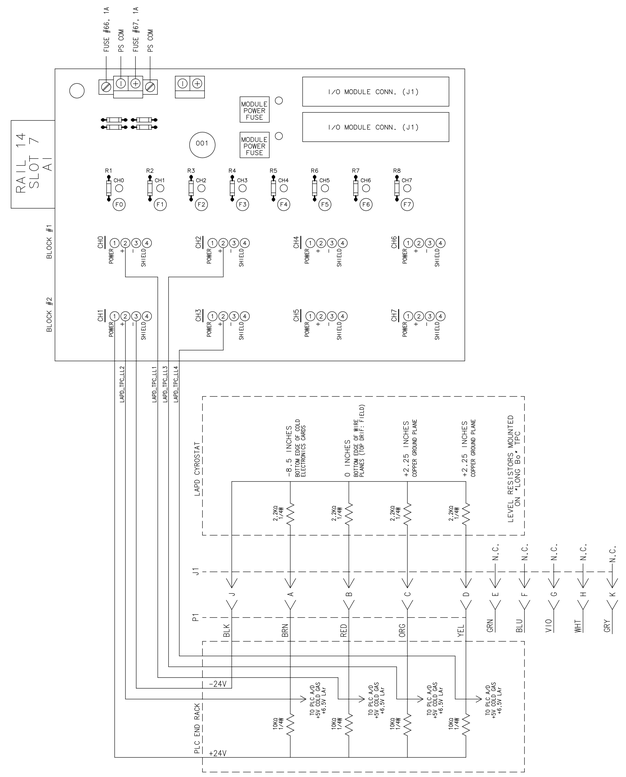
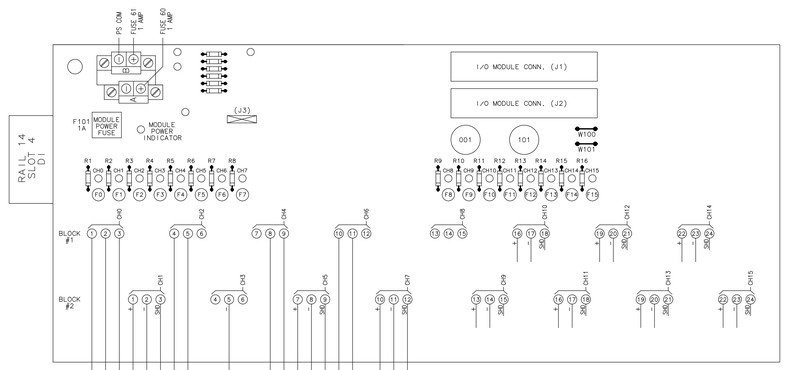
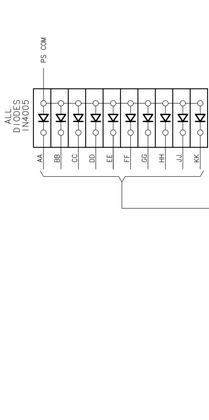
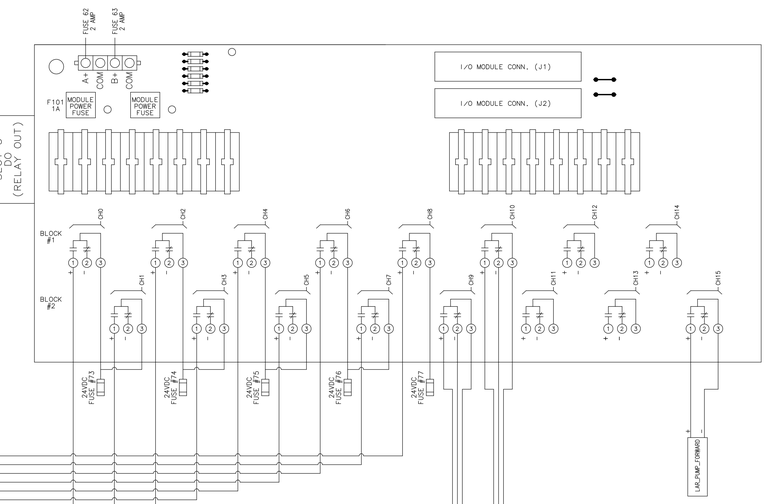
CABINET 4











NOTES:

1. POWER SUPPLY SWITCH MOST BE IN PARALLEL POSITION.
2. WIRE MUST BE 12 AWG OR EQUIVALENT.
3. JUMPERS MUST BE 8 AWG OR EQUIVALENT.

UNLESS OTHERWISE SPECIFIED			ORIGINATOR	D.MARKLEY	10-MAR-2010
			DRAWN	J.CATALANELLO	10-MAR-2010
±	±	±	CHECKED	T.TOPE	05-AUG-2010
1. BREAK ALL SHARP EDGES MAX.			APPROVED	T.TOPE	05-AUG-2010
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES			USED ON		
5. DRAWING UNITS: U.S. INCH			MATERIAL		

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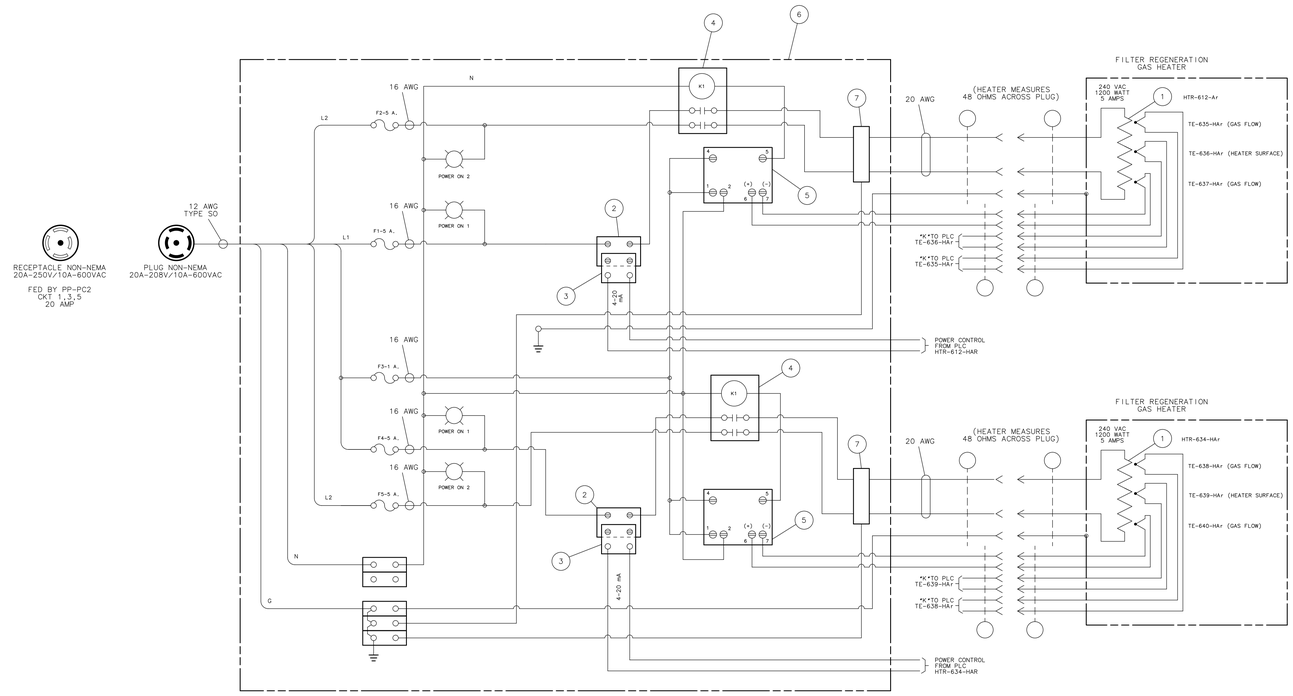
UNITED STATES DEPARTMENT OF ENERGY

FLARE-UTILITIES ELECTRONICS PPD-PC4 LIQUID ARGON PURITY-LAPD S7-PLC CABINET WIRING DIAGRAM

SCALE	DRAWING NUMBER	SHEET	REV
NONE	3942.520-EE-466801	5 OF 1	D
CREATED WITH : Ideas12NXSeries	GROUP: PPD/MECHANICAL DEPARTMENT		

REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE
A	UPDATE WIRE SIZES.	J.CATALANELLO	12-APR-2011
		D.MARKLEY	29-AUG-2011



NOTE:

ITEM 5 MUST BE PHYSICALLY RESET ANY TIME THE ASSOCIATED INTERLOCK THERMOCOUPLE IS DISCONNECTED.

ITEM	PART NO.	DESCRIPTION OR SIZE	QTY.
7	COM'L	RFI FILTER CORCOM #5VR1 NEWARK #52K3857	2
6	COM'L	HAMMOND ENCLOSURE 16"x16"x7" STOCK # 91F2192	1
5	COM'L	OMEGA LIMIT CONTROLLER #CN3261-KF	2
4	COM'L	MAGNETIC CONTACTOR OMEGA #MC1-2-30-240	2
3	COM'L	OMEGA PCM4 MODULE	2
2	COM'L	SOLID STATE RELAY DC INPUT,10 A. AC OUTPUT OMEGA #SSR330DC10	2
1	COM'L	GAS HEATER OMEGA #AHPF-122	2

PARTS LIST

UNLESS OTHERWISE SPECIFIED	ORIGINATOR	T.TOPE 02-AUG-2010
	DRAWN	J.CATALANELLO 04-AUG-2010
± ± ±	CHECKED	T.TOPE 10-AUG-2010
1. BREAK ALL SHARP EDGES MAX. 2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES 5. DRAWING UNITS: U.S. INCH	APPROVED	T.TOPE 10-AUG-2010
	USED ON	
	MATERIAL	

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

FLARE-UTILITIES ELECTRICAL SYSTEMS-DIAGRAMS FILTER REGENERATION GAS HEATERS

SCALE	DRAWING NUMBER	SHEET	REV
	3942.520-EE-486145	1 OF 1	A

CREATED WITH : Ideas12NXSeries | GROUP: PPD/MECHANICAL DEPARTMENT

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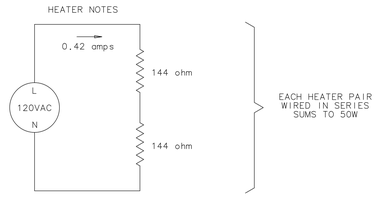
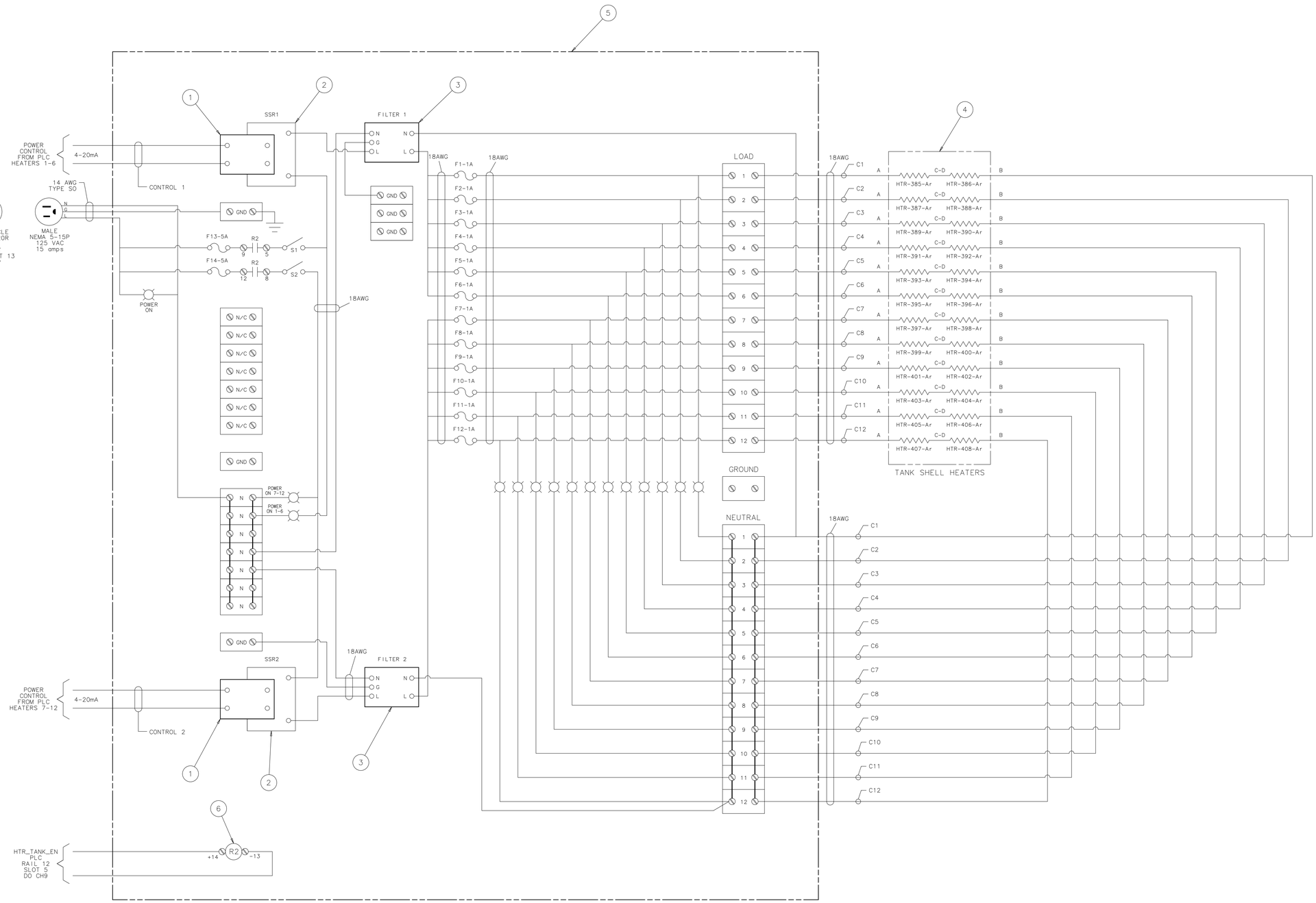
REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE
A	UPDATE WIRE SIZE.	J.CATALANELLO	12-APR-2011
		D.MARKLEY	29-AUG-2011

HEATER NOTES



THE 12 HEATER PAIRS SUM TO 600W
PINS C & D JUMPER THHE HEATERS IN
SERIES AT THE BULK HEAD CONNECTOR.



ITEM	PART NO.	DESCRIPTION OR SIZE	QTY.
6	COML	AUTOMATION DIRECT RELAY PART# GMZX-D24	1
5	COML	HAMMOND ENCLOSURE 16" X 16" X 7" PART #N1A16167 NEWARK PART #91F2192	1
4	COML	FLEXIBLE POLYIMIDE HEATER WATLOW , NOMINAL RATING 100W AT 120VAC PART #K020100C3-0009B	24
3	COML	RFI FILTER CORCOM PART #5VR1 NEWARK PART #52K3857	2
2	COML	SOLID STATE RELAY W/LED STATUS INDICATOR DC INPUT, 25 amp AC OUTPUT OMEGA #SSR330DC2S	2
1	COML	OMEGA PCM4 PULSE CONTROL MODULE	2

PARTS LIST

UNLESS OTHERWISE SPECIFIED	ORIGINATOR	T.TOPE 26-JUL-2010
	DRAWN	J.CATALANELLO 29-JUL-2010
± ± ±	CHECKED	T.TOPE 05-AUG-2010
1. BREAK ALL SHARP EDGES MAX.	APPROVED	T.TOPE 05-AUG-2010
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON ASME Y14.5M-1994 4. MAX. ALL MACH. SURFACES	USED ON	
5. DRAWING UNITS: U.S.INCH	MATERIAL	

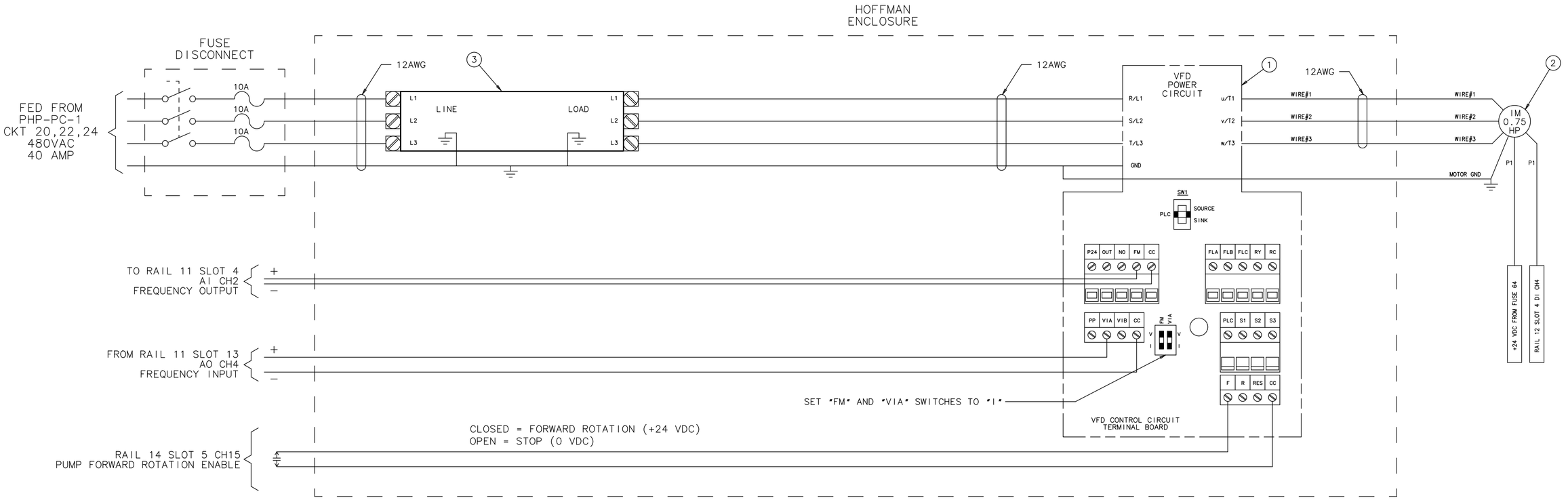
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

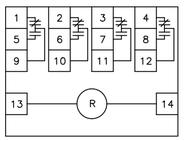
FLARE-UTILITIES ELECTRONICS PPD-PC4 LIQUID ARGON PURITY-LAPD TANK HEATERS ELEC SCHEM

SCALE	DRAWING NUMBER	SHEET	REV
	3942.520-EE-486142	1 OF 1	A

CREATED WITH : Ideas12NXSeries | GROUP: PPD/MECHANICAL DEPARTMENT

REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE
A	MISC. UPDATES AND ADD WIRE AWG SIZES AND GROUNDING.	J.CATALANELLO	11-APR-2011
		D.MARKLEY	29-AUG-2011





AUTOMATION DIRECT 4 POLE 24VDC
TYPICAL RELAY DIAGRAM
PART # GM4X1-D24
(DE-ENERGIZED POSITION)

NOTE:

THE MOTOR IS EQUIPPED WITH AN EMBEDDED KLIXON SWITCH. THIS NORMALLY CLOSED SWITCH WILL OPEN WHEN THE MOTOR TEMPERATURE EXCEEDS 300°F. MOTOR ROTATION SHOULD BE CLOCKWISE WHEN VIEWED FROM THE FAN END OF THE MOTOR. IF PUMP ROTATION IS INCORRECT, INTERCHANGE ANY TWO OF THE 3 WIRES BETWEEN THE VFD AND PUMP. DO NOT INTERCHANGE ANY OF THE WIRES BETWEEN THE VFD AND POWER SOURCE.

ITEM	PART NO.	DESCRIPTION OR SIZE	QTY.
3	COML	ROXBURGH KMF310 3PH 10A 500VAC EMI/RFI FILTER NEWARK PART# 01M8075	1
2	COML	BARBER-NICHOLS BNCP-32B-000, LONG SHAFT ARGON PUMP TOTALLY ENCLOSED FAN COOLED (TEFC)MOTOR 0.75HP 380VAC 3PH 95HZ 2 POLE INVERTER DUTY MOTOR	1
1	COML	TOSHIBA TRANSISTOR INVERTER, VFS11-4007PL-WN (R5), SOURCE 3PH 380/500V 50/60HZ OUTPUT 2.3A 1.8KVA	1

PARTS LIST

UNLESS OTHERWISE SPECIFIED			ORIGINATOR	T.TOPE	16-DEC-2010
			DRAWN	J.CATALANELLO	16-DEC-2010
±	±	±	CHECKED	T.TOPE	28-JAN-2011
			APPROVED	T.TOPE	28-JAN-2011

1. BREAK ALL SHARP EDGES MAX.
2. DO NOT SCALE DRAWING.
3. DIMENSIONS BASED UPON ASME Y14.5M-1994
4. MAX. ALL MACH. SURFACES
5. DRAWING UNITS: U.S. INCH

USED ON

MATERIAL

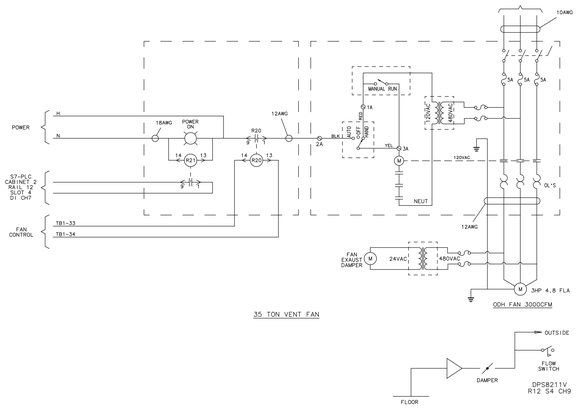
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

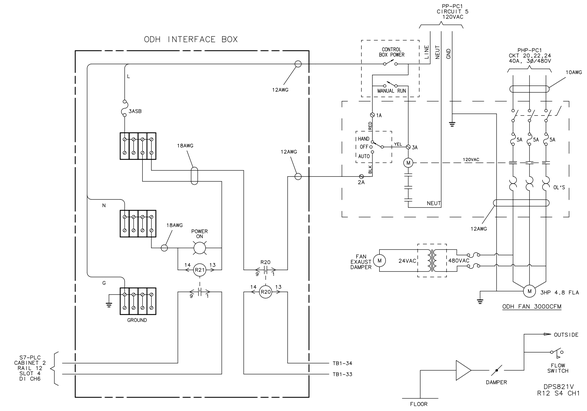
FLARE-UTILITIES ELECTRONICS LAPD LIQUID ARGON PUMP WIRING DIAGRAM

SCALE	DRAWING NUMBER	SHEET	REV
	3942.520-EC-486497	1 OF 1	A

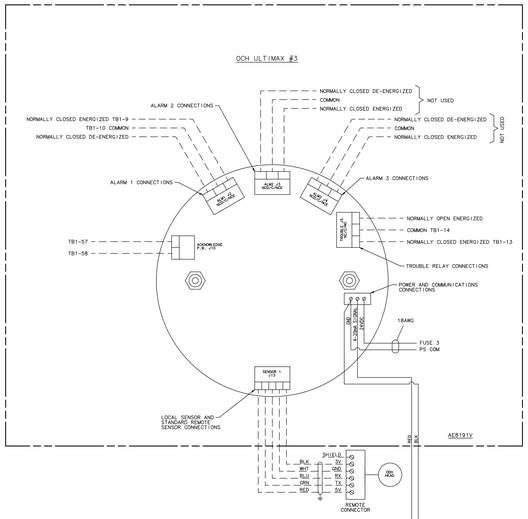
CREATED WITH : Ideas12NXSeries | GROUP: PPD/MECHANICAL DEPARTMENT

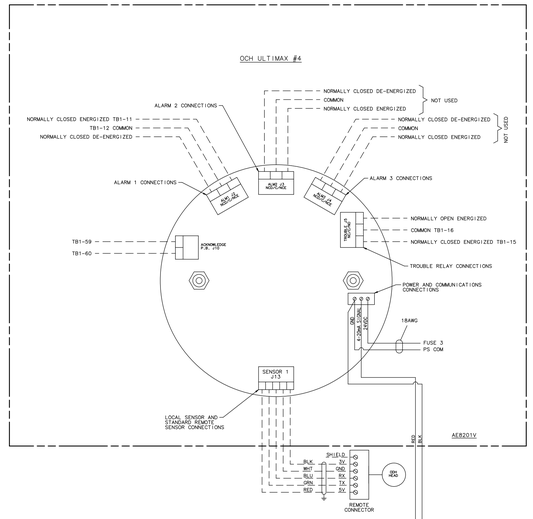
REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE

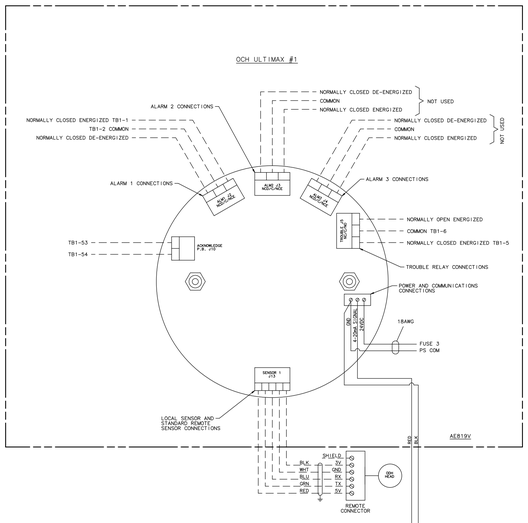


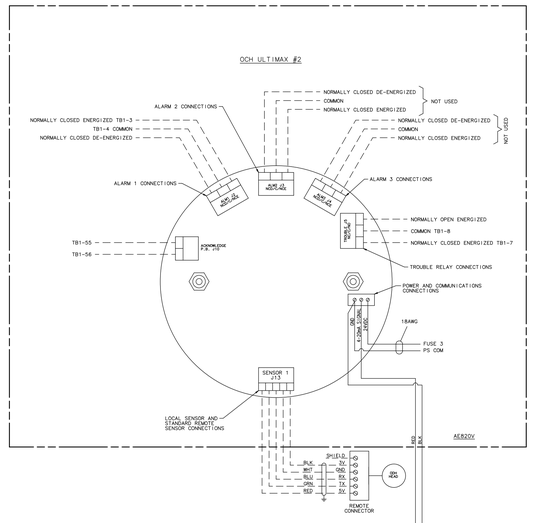


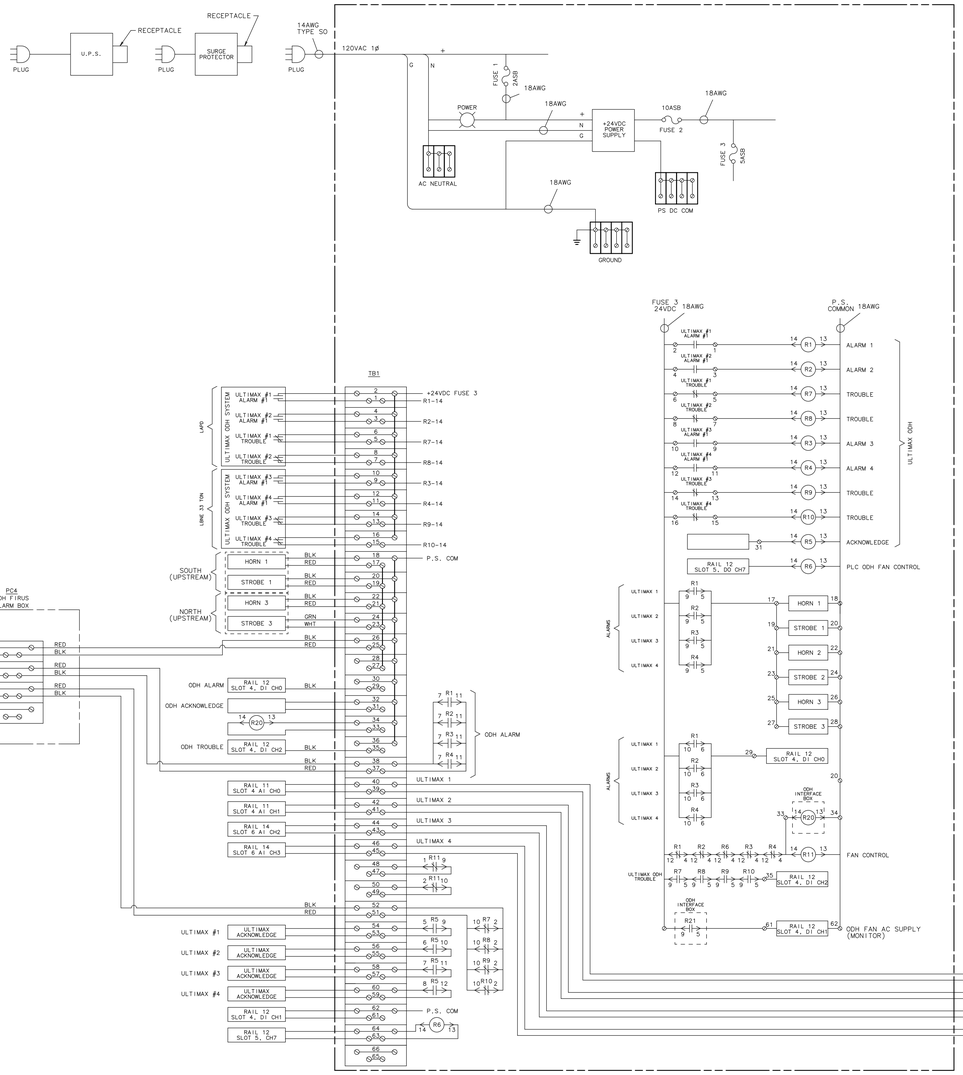
LAPD VENT FAN



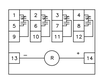


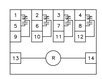






LOGIC TRUTH TABLE				
DEVICE	DISCRIPTION	ON STATE	OFF STATE	COMMENTS
R1	ULTIMAX 1 ODH ALARM	ALARM	NORMAL	TRIP POINT=19.5k
R2	ULTIMAX 2 ODH ALARM	ALARM	NORMAL	TRIP POINT=19.5k
R3	ULTIMAX 3 ODH ALARM	ALARM	NORMAL	TRIP POINT=19.5k
R4	ULTIMAX 4 ODH ALARM	ALARM	NORMAL	TRIP POINT=19.5k
R5	ACK ULTIMAX	ACK	RUN	
R7	ULTIMAX 1 TROUBLE	NORMAL	TROUBLE	
R8	ULTIMAX 2 TROUBLE	NORMAL	TROUBLE	
R9	ULTIMAX 3 TROUBLE	NORMAL	TROUBLE	
R10	ULTIMAX 4 TROUBLE	NORMAL	TROUBLE	
RAIL 12 SLOT 4 IN 10	ODH ALARM SUM	ALARM	NORMAL	
RAIL 12 SLOT 4 IN 11	ODH TROUBLE SUM	NORMAL	TROUBLE	





NOTE:

POSITION FOR HORN CARD SWITCHES

UNLESS OTHERWISE SPECIFIED	ORIGINATOR	D.MARKLEY	21-AUG-2012
	DRAWN	J.CATALANELLO	27-AUG-2012
± ± ±	CHECKED	D.MARKLEY	08-NOV-2012
1. BREAK ALL SHARP EDGES MAX.	APPROVED	D.MARKLEY	08-NOV-2012
2. DO NOT SCALE DRAWING. 3. DIMENSIONS BASED UPON	USED ON		
4. MAX. ALL MACH. SURFACES	MATERIAL		
5. DRAWING UNITS:			

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

FLARE UTILITIES ELECTRONICS LBNE 35 TON PROTOTYPE ODH SYSTEM WIRING DIAGRAM

SCALE	DRAWING NUMBER	SHEET	REV
	3942.520-EE-489928	1 OF 1	

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